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Electrical World

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December 29, 1923

1923

As 1923 Passes Into History, the electrical engineer and those who have joined with him to build the allied industries based on his knowledge and his work have the assurance afforded by one more year's successful accomplishment that they have built wisely and well. In new ways and with expanded usefulness electricity has in the year now closing contributed more than ever to man's happiness and prosperity, to healthy social growth and industrial progress.

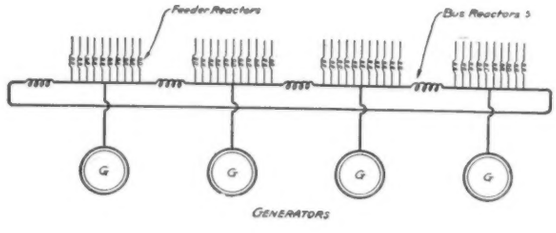
The sense thus attained of useful service, added to the "will to do" of electrical men everywhere, makes it certain that the future will see still greater things done, still larger contributions to progress made through the agency of electricity, the most untiring and most adaptable servant of mankind. With full confidence, therefore, that the new year will advance still further the boundaries of achievement set by 1923, the Electrical World wishes you

1924

A Happy And

Prosperous New Year

UNION GAS & ELECTRIC CO., CINCINNATI



Re-orders Metropolitan Reactance Coils for Feeder Circuits

This diagram shows how Metropolitan reactors protect the generators and feeders at the West End Station of the Union Gas & Electric Co., Cincinnati, Ohio.

This company first used this type of protection for generators with the result that Metropolitan reactors were specified for feeder protection.

Metropolitan reactors are used by the big Edison Companies in New York, Boston, Chicago, Detroit, Brooklyn, etc. Also they are standard equipment not only in the central station but in the industrial field as well.

If you desire data on your own plant, *write us today.*

Partial List of Metropolitan Reactor Installations

Edison Elec. Illuminating Co., Brooklyn
Calgary Municipal Electric Co.
Canadian Niagara Falls Power Co.
Cataluna Power Co.
Cohoes Light & Power Corp.
Commonwealth Edison Co., Chicago
Consolidated Gas & Electric Co., Cincinnati
Dayton Power & Light Co.
East Hampton Gas Co.
Edison Electric Illuminating Co., Boston
Edison Illuminating Co., Detroit
El Paso Power & Railroad Co.
French General Electric Co.
Hydro Electric Power Commission, Ontario
Interborough Rapid Transit Co., N. Y. City
Joyce Gridland Railroad Co.
Municipal Gas & Electric Co., Albany
Potomac Electric Co.
Public Works Department, New Zealand
Public Service Electric Co. of New York
Shawinigan Hydro Elec. Power Co.
Tennessee Power Co.
Toledo R. R. & Light Co.
Toronto Power Co.
Turners Falls Power Co.
United Electric Light & Power Co., N. Y. City
United Electric Light & Power Co., Springfield
Union Gas & Electric Co., St. Louis
U. S. Explosives Plant, Nitro
Utica Gas & Electric Co.
Victoria Falls & Transvaal P. Co.
Warren & Co.
Youngstown Sheet & Tube Co.
New York Edison Company
N. Y., N. H. & H. R. R. Co.
N. Y. & Queens Elec. Light & Power Co.
Chicago, Lake Shore & South Bend R. R.

Metropolitan Device Corporation

1250 Atlantic Avenue, Brooklyn, N. Y.

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Men Who Create

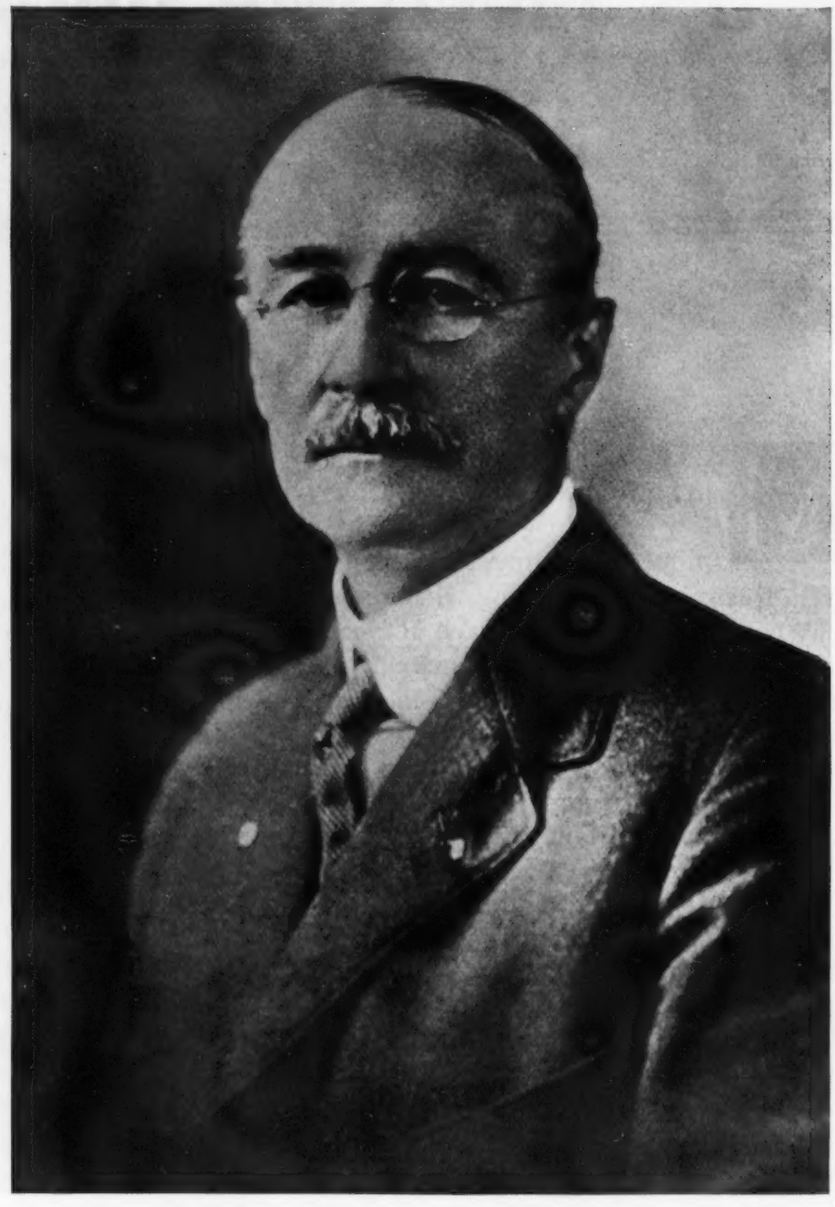
MANY men "build better than they know." Comparatively few who do great work along pioneering lines realize or even dream in the beginning what results may come. To most men each act, each accomplishment, has significance only in relation to the problem of the moment. Thus those who have a practical vision of the future and how to build for that future stand out strongly in contrast with their fellow men. The advance of society and industry is measured by the sum total of the contributions of all, but this advance is both accelerated and directed by those who through technical ability or through genius for leadership work with the fundamental idea of building for the future. And those who through the exercise of rare creative genius or through perseverance in investigation and infinite patience make possible entirely new achievements rightly rank first. However much others may add, their contribution alone is indispensable.

The electrical industry and the electrical art provide the most outstanding example of the results obtained through the combination of inventive genius and sound business development. The early engineers had a real vision of what their work might accomplish, though their vision fell far short of the realization. Others who came into the industry and associated themselves with the engineers to help build upon their technical achievements have shown marvelous courage and foresight in their work. There has thus come to be a class of men whom the electrical industry recognizes as primarily responsible for its present success and future opportunities. Their records stand as encouragement and inspiration to others already in the industry and to the younger generation as it grows into its own responsibilities.

It is for this reason that the ELECTRICAL WORLD for the past three years has published photographs of such men accompanied by short appreciations of their individual contributions to the industry. Some have been overmodest and have refused the use of their portraits, but the long list presented, with more to come from time to time, will form a fitting tribute to the genius and ability which have been responsible for the upbuilding of the electrical art and industry in America. Believing that it will be an enterprise well worth while, and indeed in response to numerous requests, the ELECTRICAL WORLD plans to publish as a book this series of personal photographs and appreciations. Such a collection will undoubtedly find a welcome as a permanent record of the relation of the men who create and build to the industry which their vision and their labor has called into being.

Sidney Borden Paine

A pioneer and foremost authority in the application of electricity to the textile industry.



FOR thirty years Sidney B. Paine, manager of the mill-power department of the General Electric Company, has rendered distinguished service as a liaison officer between the electrical and the textile manufacturing industries. As a boy in Fall River, Mass., he grew up in the atmosphere of cotton-mill activities, and after a comparatively short term of service in Edison central-station development in New England the opportunity came to undertake the pioneer cotton-mill electrification of the world at the Columbia Mills Company plant in Columbia, S. C. The motors (polyphase induction type) went into service in 1894 in 65-hp. units and are still in operation. Upward of 1,500,000 hp. in motors is today at work in the textile industry, and the adoption of electric drive has become a foregone conclusion in every new installation, while the electrification of old plants is proceeding very fast.

Mr. Paine was born in 1856 and was educated at the Brooklyn Polytechnic Institute and abroad. His earlier work in the electrical industry was in association with W. H. Francis, another Edison pioneer, in introducing Edison central-station equipment and service into New England. When the General Electric Company and the Thomson-Houston Electric Company joined hands, Mr. Paine was appointed manager of the power and mining department, with headquarters at Boston, and in 1903, in recognition of his vision of electrical possibilities in the textile industry, he was made manager of the mill-power department.

At all times Mr. Paine has worked in close contact with the designing engineers at the factory, and many of his ideas have been embodied in the equipment which has been developed to meet the expanding needs of the great textile industry, the four-frame drive of spinning machinery being conspicuous among these. Mr. Paine's knowledge of the textile industry includes a profound understanding of the service requirements of its branches from the standpoint of electrical engineering, and he has constantly striven to convince mill owners and operators of the wisdom of installing motors of adequate rating in relation to prospective future developments in character of product, volume of output and arrangement of manufacturing processes. He has made several trips to investigate the textile industry in Europe. In his analytic power, constructive understanding of industry needs and sales ability he stands among the foremost authorities in the world of textile power application.

Editorial Comment

Electrical World, December 29, 1923

Volume 82 Number 26

Human Relations

NO GROWTH in the size of central-station systems, no increase in the complexity of operations or in the organizations of personnel, can affect the humanness of human relations. Customers will continue to be men and women, employees will be no less individuals, and both will go on until the end regarding the chief executive of the utility company as a neighbor or a stranger who is frank, fair and friendly or otherwise, as the case may be. It is a capital idea, therefore, to pause during this week of the holidays to think about these things. Christmas carries an inspiration toward good will to men; New Year's Day prompts us all toward introspection and a candid scrutiny of our affairs. Let it be asked, therefore, what are the fundamental concerns of the utility executive, the manufacturer, the jobber, any business man who heads an organization?

The vital elements in any business, after all, are three —employees, customers and stockholders—the men and women for whom the business is really run. These are the chief interests. Policies, traditions, ambitions, rules, regulations, personal privileges, all should be secondary to the loyal, helpful service of these three groups. Presidents, general managers, department heads, all executives are merely skilled men employed and authorized to carry forward these great personal interests in behalf of the many who intrust this business to their direction. They expect good stewardship and are entitled to it, freely given. It is a wise executive who sees this all clearly and keeps the thought of it ever forward in his mind. He inevitably profits in three very practical ways. His employees are more contented and therefore more efficient. His customers are more appreciative and therefore easier to sell to and to serve. His stockholders are more interested, more satisfied and therefore more responsive to new needs for capital. Good stewardship adds immeasurably to the possibilities for achievement and to the joy of living.

The Christmas Tree at the White House

AN ELECTRICALLY lighted outdoor tree has this year become a feature of the Christmas celebration at the White House. Middlebury College cut a great tree and presented it to President Coolidge as a gift from his native state. It was installed in the "White Lot" and decorated with many electric lights. Appropriate ceremonies were held on Christmas Eve, with carols by children and music by the Marine Band. The President turned on the lights. The growing popularity of the electrically lighted outdoor tree as a modern symbol of the Christmas festival thus receives new impetus that will carry to the farthest parts of the country.

This tree at the White House, with its national significance, comes as the indirect outgrowth of the original "tree of light," with its attendant ceremonies, that first marked the Christmas services in Madison Square, New York City, several years ago. The idea has since spread across the country. The suggestion for the White House tree originated with the Society for Electrical Development and was carried through by the co-operation of a number of electrical men in Washington.

The electrical industry may well feel pride in the part that it is playing—through the use of electric light and radio—in this new expression of the spirit of Christmas. It deserves the most enthusiastic support from electrical men and women in every city in order that some day the electrically lighted tree may come to stand before the world as the symbol of symbols of Christmas and all it means to young and old.

Corporate Interference with Freedom of Teaching

SOME members of the American Association of University Professors appear to be alarmed over the real or supposed interference of industrial and financial corporations with the freedom of teaching. Influence, mostly in the form of suggestions, they claim, has been brought to bear on them in the teaching of economics, in courses on corporations and finance, public utility courses, public speaking and composition, and even in purely technical subjects involving machinery or chemical process. Why a university instructor, even one most imbued with the idea of academic freedom, should want a Chinese wall between himself and the practical side of the subject he is teaching is not quite understandable. Certainly, a corporation or industry interested in any policy has a right to keep teachers informed on the reasons for that policy and, through representatives, literature, apparatus, or in some other way, to manifest an interest in the education of young men some of whom it expects to employ.

The ELECTRICAL WORLD has little sympathy with the oversensitive teacher who sees in an innocent suggestion a big stick, even though it is possible that some overzealous representative of industry has at times not exercised much discretion in dealing with departments of applied science in our universities. Speaking of the big groups in our own industry, it is hard to imagine any attempt at coercion, for the simple reason that we need broad-minded men who can think independently and reach logical conclusions. The leaders in the electrical industry, if given their choice, are not likely to choose passive young men "stuffed" with information and policies, but independent young men trained to get all

the facts in a given case and who can analyze them carefully, draw impartial conclusions and adopt a logical course of action. Effort toward that end is a scholastic contribution and not interference.

Publishing Operating Results Stimulates Economy

IF OPERATING records of electrical generating stations could be published each year in such form as to give a real indication of station performance, there is reason to believe that operating economies would result from the spirit of rivalry that would be engendered by the published figures. In this country no really informative data are published on station operation, nor, as a matter of fact, is there much privately circulated, and the tables showing the performance of stations here and there that appear spasmodically are usually not of sufficient thoroughness to give the information necessary for exact comparison. As a general thing some important data are lacking and costs may well be questioned as to their general application.

The greatest drawback to the publication of station production data is removed when direct costs are eliminated. Costs are not essential to performance comparisons on a thermal basis, and it would seem feasible to draw up a standard form of data sheet by the use of which the desired results could be obtained. The N. E. L. A., the A. I. E. E. or the A. S. M. E. could do much in formulating a co-operative solution to this problem, for the material thus obtained would undoubtedly be of great benefit to the industry.

Only Unbalanced Circuits Introduce Appreciable Reactive Metering Errors

WITH the very large kilowatt-hour outputs of modern electrical systems, metering accuracy becomes of great economic importance. The money involved as a result of errors in metering is so large that adherence to an accuracy of at least one-half of 1 per cent is warranted on large kilowatt-hour meters, and fortunately the development of this type of meter has kept pace with the economic demands in the art of measurement. For energy measurements on any scale, meters of simplicity, reliability and accuracy are available for service.

But in that class of measurement involving "investment metering" it has been stated that there is not the same degree of development or of precision in measurement and that meters nearly all measure approximate values only and are subject to errors when the voltage or power factor varies or the circuit becomes unbalanced. Questions and statements of this character are to be expected, because this class of metering is of comparatively recent origin and requires the application of more complex electrical principles to insure accurate results. The motor or energy principle must give way to the capacity or wattless principle in many cases, and the available mechanisms become complicated and expensive.

Particularly in reactive metering does this condition hold true, and those confronted with this phase of metering problem will be very much interested in the article in this issue by Prof. A. E. Knowlton of Yale University, who is also electrical engineer of the Public Utilities Commission of Connecticut and who brings to his study a great deal of experience with metering practice. This article analyzes thoroughly the theoretical and practical limitations of the art and defines the degree of accuracy to be expected under different conditions of operation. The study shows that errors are introduced by unbalanced circuit conditions with all cross-connected metering schemes applied to usual types of meters and that inherently these errors cannot be eliminated except by a redesign of meters so as to bring the potential flux in phase with the potential.

On the other hand, the error introduced by unbalance favors the consumer, is small in magnitude and occurs only in those few commercial installations where unbalanced conditions prevail. And it is encouraging to note that the degree of accuracy required in this type of measurement, which seeks to measure values proportional to investment, is fulfilled in the general case, so that an understanding of the points indicated in the article should serve to help meter engineers adapt their meters to the special conditions that are encountered.

Short Cuts in Rural Rates Are Based on Error

CENTRAL-STATION men in several localities in the United States are courting future trouble in the formation of their rural-service rates through a failure to recognize the fact that there is not enough information available on the character of the business, nor is the business itself well enough developed, to allow the formation of a new "class of business" rate. Because the present state of the business points to the conclusion that it will be a new class and that allowances must be made for new conditions to be met, some are apparently jumping to the conclusion that existing conditions are final and are attempting to solve the rate question by short-cut methods.

It is important to differentiate between the "rural charge" as used in any of the present forms of rural-service rules and a "fixed charge" in the sense that the term is used in other rate schedules—power, for example—where there is some degree of stabilization in costs of service. In the Wisconsin rural-rate development it was recognized that the problem was largely made up of unknowns. Certain class rates established under commission rule and therefore legally adequate were available as a starting point. As a measure to be used until the problem is better understood an "excess charge" under the name of "rural charge" was added to the urban rates. The committee of the Wisconsin Utilities Association and the commission recognized the temporary nature of the rules and carefully tried to bring into the method of computation all the factors covering costs and revenue. It then provided for yearly adjustments under which the excess charge can be wiped out and the farm consumer put on the same basis as his urban neighbor if his energy use justifies the change. From this it can be seen that the rural charge in Wisconsin is purely an excess-cost charge and not what is implied in the ordinary use of the term "fixed charge." In the final development of the business the charge now used may not have any relation whatever to the fixed charge that the business will justify. On the other hand, it may be the final answer. Until the answer is known the customer is in position to receive whatever advantage his increase in business justifies and wipe out the excess cost if he can.

Almost every other effort to simplify the computation of rates has been based on the assumption that the present condition is a permanent one. The fact that the method used in Wisconsin has been to take an established rate and add an excess charge to it, which can be wiped out by increases in the use of energy, is forgotten, and the resulting short cuts tend to establish the excess charges on present conditions with no opportunity for adjustments as these developments occur.

Committees working on the subject should travel slowly and leave methods of adjustment that will keep the rates on a par with growth, be it much or little. In this connection it will be interesting to watch the rural electrification research work in Minnesota. Here the rates are based on a fixed charge covering all items of investment, maintenance and operation so far as the utility makes the investment. Energy charges are made at a low rate, and the average rate becomes what the customer's use of energy makes it. While computations like these or like those employed in the Wisconsin method may be cumbersome, they have the merit of showing up the conditions as they are and leave no chance for self-deception. They do not encourage slipshod guesswork or the building of poor and improper rate schedules, such as have already characterized some rural-line developments, to be a bugbear to the industry in the future.

Arizona Still Spikes Colorado River Projects

THE sovereign state of Arizona has become ambitious. Not that ambition is unpraiseworthy; but Arizona is animated by the kind of ambition that Wolsey charged Cromwell to fling away and for which Brutus slew Cæsar—an ambition which upon analysis proves to be covetousness. The Colorado River is rich in potential water power, and by the gift of nature some of the finest water-power sites are in the canyons of Arizona. Hence Arizona, with an eye single to her own advantage, seeks to exact tribute on all Colorado River power developments within her borders. That is the reason why she refuses to sign the seven-state treaty proposed by Herbert Hoover and ratified by all the other states through which the Colorado and its tributaries flow.

State development of water power by Arizona as suggested by her Governor is merely a gesture. Any one development would cost more millions than Arizona can raise, and where Arizona expects to get the money her Governor does not say; nor does he say where she expects to sell the electricity, granted it is ever generated. Nor does it reflect any credit on commission regulation to have Governor Hunt intimate that the entire cost of development be saddled on the users of power, when flood control and irrigation are such important features. Covetousness, however, cannot prevail, although it will serve to delay development in the lower states of the Colorado Valley. Had private enterprise, under the law, been permitted to carry out its plans, work on at least two major developments would now be under way, even though it might involve $150,000,000. Since political interference, however, has asserted itself, another decade will probably pass before the canyons of Arizona echo and re-echo the sound of the air drill and explosives.

Capacity Factor Is a Measure of Utilization of Capital

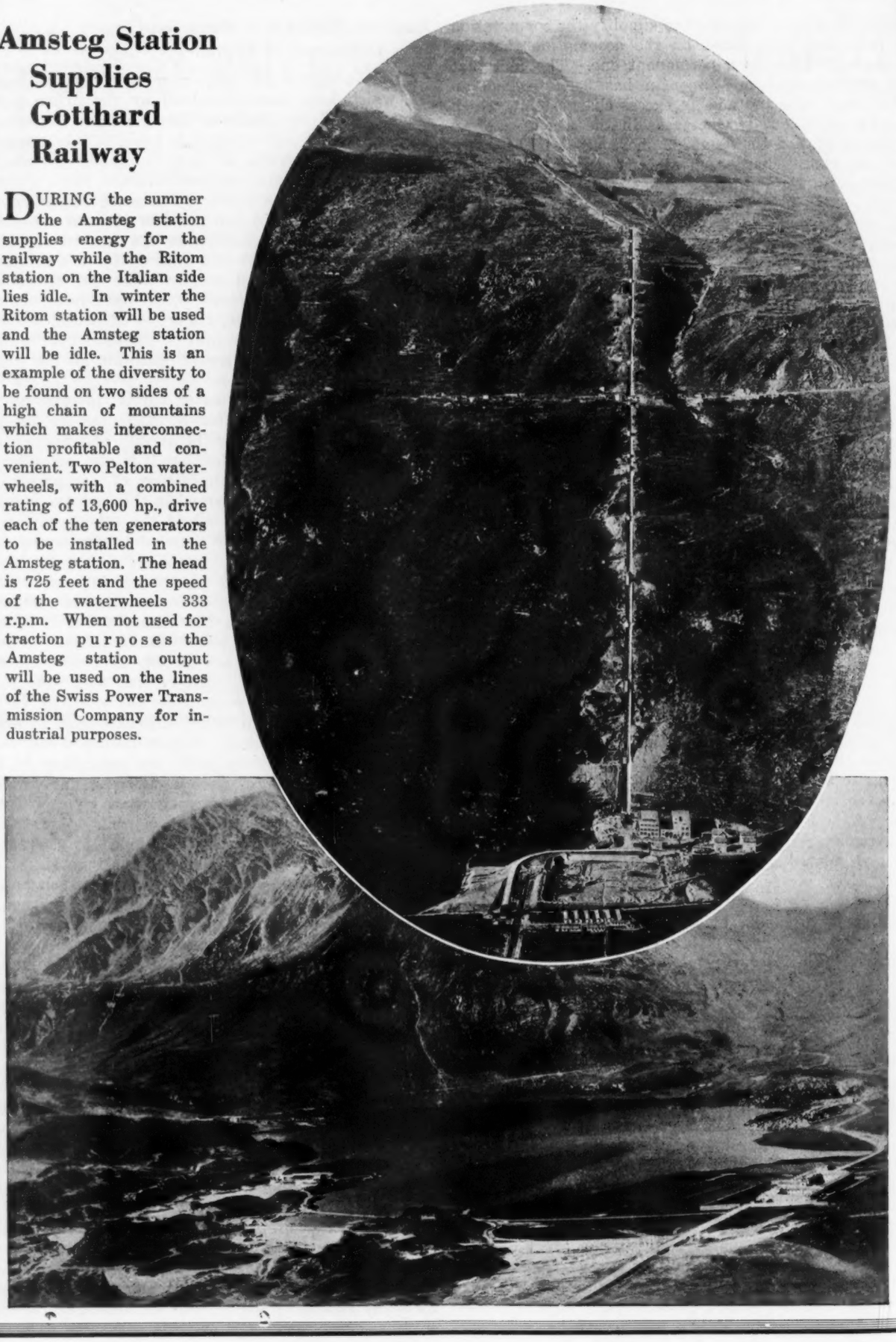
THE analyses of turbo-generator service records which have been presented by the prime movers committee of the National Electric Light Association in recent years, and which it is hoped will be continued in the future reports, are very enlightening regarding the extent of useful service obtained from different installations in this country, but more important still is the use a company can make of its own equipment, since a unit may be operated at less than its rated load or may be held off the line entirely for a considerable period of each year at certain times during the day. According to some records which have been made of capacity factor (that is, the ratio of actual kilowatt-hours developed by each unit to the total that could be developed if the unit were in operation all the while), it is only 30 to 40 per cent on the average. This indicates a relatively small use of capital investment. Of course, the capacity factor is influenced by the load factor of the plant and by the amount of reserve capacity carried for emergencies, but it is also dependent to a great extent upon obsolescence of equipment. In fact, out of 268 units observed in this country only five are seventeen years old, all of the others having replaced older units because they were more modern and more economical.

When it is considered how much turbo-generators with condensers and auxiliaries cost, most companies will not have to be told how important it is to have records of the extent to which this investment is being used. Some companies are already keeping them as a guide to operation, and blank records which the N. E. L. A. prime movers committee has sent to various companies for filling in should stimulate more extensive compilation of these data. It is to be hoped that every company will co-operate with the committee in this laudable undertaking. Such a record is not difficult to keep where kilowatt-hour meters are connected with each generator. The yearly or monthly kilowatt-hour output of each machine can be divided by the energy which it could develop if operated continuously at full load throughout the entire period. Many such records are kept, but unfortunately some of them are not interpreted. When they are the chief engineer will be in a better position to ascertain why the units are not being used to a fuller degree. If they are being held off the line because they are obsolete and uneconomical, it may pay to ascertain whether they can be disposed of at a desirable price before they lose all save junk value. In some cases, however, it may be that their availability for emergencies is worth more than the price which could be obtained for them. Sometimes it is even possible to modify them, to adapt them to new operating conditions. If obsolescence is not the cause of their low capacity factor, this is probably due to the low load factor of the station. In this case it is a problem either for the commercial department to improve the load or for the engineering department to divide the load differently so that maximum capital utilization consistent with reliable service can be obtained.

In any event, a greater consideration of the use factor of expensive equipment like turbo-generators is advisable, and easily kept records will serve as a very excellent guide for increasing the utilization of the capital represented.

Amsteg Station Supplies Gotthard Railway

DURING the summer the Amsteg station supplies energy for the railway while the Ritom station on the Italian side lies idle. In winter the Ritom station will be used and the Amsteg station will be idle. This is an example of the diversity to be found on two sides of a high chain of mountains which makes interconnection profitable and convenient. Two Pelton waterwheels, with a combined rating of 13,600 hp., drive each of the ten generators to be installed in the Amsteg station. The head is 725 feet and the speed of the waterwheels 333 r.p.m. When not used for traction purposes the Amsteg station output will be used on the lines of the Swiss Power Transmission Company for industrial purposes.



Tests on Accuracy of Reactive Metering

The Method of Metering and the Degree of Unbalance of Voltages and Currents Enter Into the Question—Analytical Study and Experimental Results

By ARCHER E. KNOWLTON
Assistant Professor of Electrical Engineering, Yale University

THE subject of reactive metering is important in connection with the commercial application of demand and power-factor clauses. The experimental and theoretical analyses of Professor Knowlton as given in this article should clearly indicate the possibilities, limitations and accuracy of present methods of reactive metering.—*Editors.*

REACTIVE metering has assumed its place in the field of electrical measurements only because the previous metering of energy did not permit the power service to be vended at a rate commensurate with the cost of rendering it. Reactive metering aims to recover in an equitable way for the cost of plant capacity devoted to a given service as well as for the costs associated with generating the kilowatt-hours consumed. Much progress has been made in convincing power users that it is equally appropriate to be charged for the power they take from the line and *retain* and for the power they take during one portion of the cycle and *return* during some other portion of the cycle. They have derived benefit from the "borrowed" power by way of excitation in transformers, induction motors, etc., and are persuaded to pay accordingly.

Loads of abnormal power factor are primarily the ones necessitating reactive metering, and not infrequently these loads become unbalanced as to line currents or phase voltages or both. It is important, therefore, to determine the degree of inaccuracy, if any, that may result in the various types of reactive metering when conditions of unbalance occur. Some reactive metering schemes are seriously in error when ordinary unbalance occurs; others are of sufficient accuracy to be commercially acceptable even with a large degree of unbalance. It will be seen from the tests and analysis that the degree of accuracy is dependent on the relation between the current and voltage unbalance. Unbalance is hardly a desirable condition; it would therefore be viewed as fortunate if any error of reactive metering, and therefore of power factor, proved to be in such a direction as to penalize the power user who occasioned the unbalance. It would also appear to be equitable if the error resulted in an apparent power factor better than the actual power factor of the customer whose load is of such a nature as to neutralize in part the voltage unbalance occasioned by the loads of other customers. This will be found to be the case with certain of the tests here reported. (See the fifteenth to twentieth sets of readings in Table II.)

Another fortunate aspect of the situation is that the errors are relatively small with ordinarily existing conditions of unbalance; also that the errors in the more common schemes exist only when both current and voltage are unbalanced at the same time.

TABLE I—ERRORS IN METERING REACTIVE COMPONENTS
(Method (*b*), potentials interchanged), connections as in Fig. 1 (*b*)

	Load Connected Between CA Kva.	CA P.F.	BC Kva.	BC P.F.	AB Kva.	AB P.F.	Total Kw.	Total Reactive Component: True	Indicated: A	Indicated: C	Indicated: Total	Error, per Cent	Total Kva.: True	Total Kva.: Indicated	Error, per Cent	Power Factor: True	Power Factor: Indicated	Error, per Cent
Balanced non-inductive	100	100	100	100	100	100	300	0	0	0	0	0	300	300	0	100	100	0
Two-phase non-inductive	100	100	0	...	100	100	200	0	43.3	—43.3	0	0	200	200	0	100	100	0
	0	...	100	100	100	100	200	0	0	43.3	43.3	00	200	204	2	100	97.8 lg	—2.2
	100	100	100	100	0	0	200	0	43.3	0	43.3	00	200	204	2	100	91.7 ld	—8.3
Single-phase non-inductive	0	...	0	...	100	100	100	0	43.3	0	43.3	00	100	109	9	100	91.7 lg	—8.3
	100	100	0	...	0	...	100	0	0	—43.3	—43.3	00	100	109	9	100	91.7 ld	—8.3
	0	...	100	100	0	...	100	0	.....	.....	.....	0	100	100	0	100	100	0
Balanced inductive	100	50	100	50	100	50	150	259.8	129.9	129.9	259.8	0	300	300	0	50	50	0
Two-phase inductive	100	50	0	...	100	50	100	173.2	86.6	43.3	129.9	—25	200	164	—18	50	61	22
	0	...	100	50	100	50	100	173.2	129.9	86.6	216.5	25	200	238	19	50	42	—16
	100	50	100	50	0	...	100	173.2	43.3	129.9	173.2	0	200	200	0	50	50	0
Single-phase inductive	0	...	0	...	100	50	50	86.6	86.6	0	86.6	0	100	100	0	50	50	0
	100	50	0	...	0	0	50	86.6	0	43.3	43.3	—50	100	66	—34	50	75.6	51.2
	0	...	100	50	0	0	50	86.6	43.3	86.6	129.9	50	100	139	39	50	35.9	—28.2
Mixed	100	100	100	50	100	100	250	86.6	86.6	43.3	129.9	50	265	282	6	94.5	88.7	—6.1
	100	50	100	100	100	100	250	86.6	0	86.6	86.6	0	265	265	0	94.5	94.5	0
	100	100	100	100	100	50	250	86.6	43.3	0	43.3	—50	265	253	1	94.5	98.7	4.5
Mixed	100	50	100	50	100	100	200	173.2	86.6	129.9	216.5	25	265	295	11	75.6	67.9	—10
	100	100	100	50	100	50	200	173.2	129.9	43.3	173.2	0	265	265	0	75.6	75.6	0
	100	50	100	100	100	50	200	173.2	43.3	86.6	129.9	—25	265	238	—10	75.6	83.9	11

The subject of reactive metering has been discussed to a considerable extent in the ELECTRICAL WORLD and elsewhere, and several different schemes are in common use. One of the schemes which is not in common use avoids the error mentioned by employing a watt-hour meter that has been modified in its potential circuit so as to bring the potential flux into phase with the potential (a power meter is regularly lagged so as to bring the potential flux into quadrature with the potential). A meter so modified or designed will experience no torque when potential and current are in phase (100 per cent power factor) because there will then be no time-phase difference of fluxes in current and potential poles of the meter. It will, as it should, indicate zero reactive component. With the other extreme of zero power factor it will experience torque and register only the reactive component. This scheme of reactive metering has not come into extensive use largely because the other schemes employ standard watt-hour meters without modification, and this is considered essential, partly to simplify meter administration and partly to avoid an unfavorable effect on the consumer. This type of reactive metering has the additional advantage that it is independent of the phase rotation; the reactive meter will not register negatively if two of the service leads happen to become interchanged.

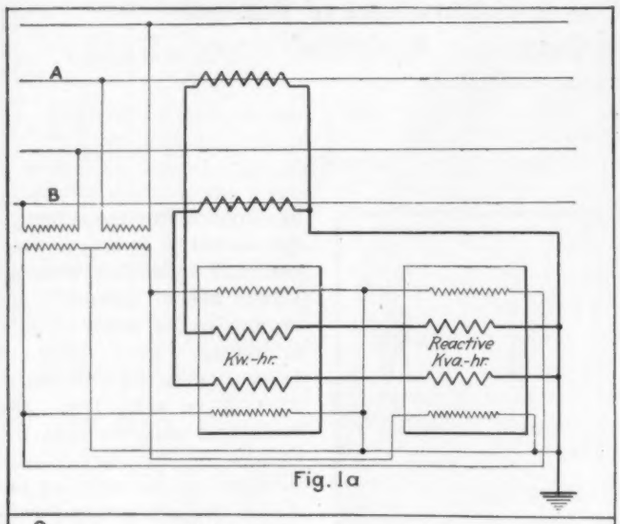


Fig. 1a

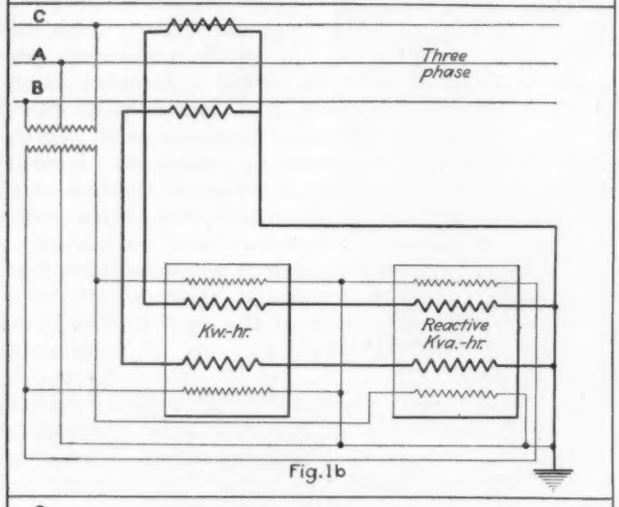


Fig. 1b

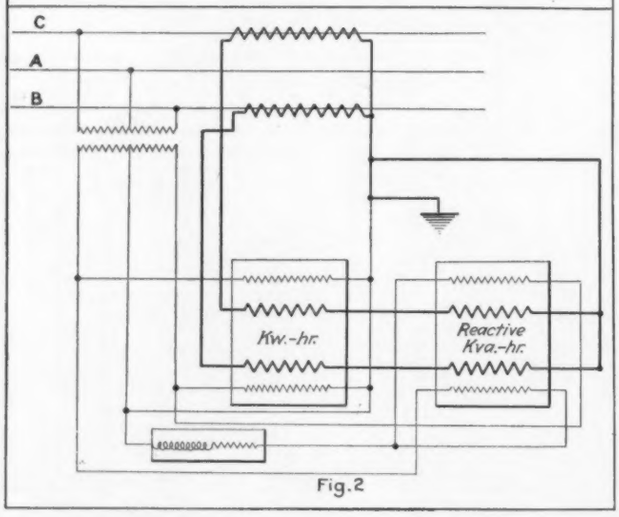


Fig. 2

FIG. 1 (A) AND (B)—SPECIAL CONNECTIONS AND THEIR ERRORS

(a) With this connection an error occurs if both the currents and the voltages are unbalanced. (b) A two-element meter with connections so as to interchange phases produces errors when either currents or voltage are unbalanced.

FIG. 2—ARTIFICIAL NEUTRAL REQUIRES A SPECIAL METER

In addition to normal unbalance errors a serious error is introduced if the neutral is displaced because of differences in the three star impedances.

TABLE II—METER TORQUES

(Determined from vector diagrams shown in Figs. 8 and 9)

Element	System	Watt-Hour Meter Voltage	Watt-Hour Meter Current	Watt-Hour Meter Torque	Reactive Meter Voltage	Reactive Meter Current	Reactive Meter Torque
Upper	Positive	p^{E}_{ba}	p^{I}_{b}	+	M	p^{I}_{b}	—
Upper	Negative	n^{E}_{ba}	n^{I}_{b}	—	nM'_{b}	I	+
Lower	Positive	p^{E}_{ca}	p^{I}_{c}	+	N	p^{I}_{c}	+
Lower	Negative	n^{E}_{ca}	n^{I}_{c}	—	N'	n^{I}_{c}	+
Combined	Positive			+			+
Combined	Negative			—			+
Resultant	Both			+			+

This discussion is not intended to apply so much to two-phase as to three-phase conditions, but for the sake of a measure of completeness in classification one common two-phase scheme will be included.

INDIVIDUAL METHODS OUTLINED

(a) *Two-Phase, Phases Interchanged.*—An ordinary two-element polyphase watt-hour meter will integrate the reactive component if connected with a current coil of each element in each phase but with potential impressed on each element from the other phase than that from which the current was taken. If the phase voltages are equal and in quadrature, the registration is correct for any power factor or for any degree of current unbalance between phases. If both currents and voltages are unbalanced (or if phase voltages are not in quadrature) there will be an error of the same sort as will be demonstrated for three-phase schemes. The connections are shown in Fig. 1a.

(b) *Three-Phase, Two-Element Meter, Phases Interchanged.*—This is the three-phase equivalent of the above. The two current coils are connected respectively into two line wires and then the potential coil of each element is connected across the two line wires not connected to the current coil of that element (Fig. 1b).

Definite polarities must be observed, and these can be verified by test. Each element should run forward when the load is known to be inductive. It should be noted, however, that the relative polarities of the elements will be correct when the service side of one potential coil and the load side of the other are connected to that line wire not connected to either current coil.

This method is correct when voltages and currents

are strictly balanced; it is inherently incorrect when both are unbalanced and even when only currents or only voltages are unbalanced. In this respect it is more to be avoided than several of the other "cross-connected" schemes. The errors may be quite serious even with ordinary conditions of unbalance—it even makes a difference in registration whether a single-phase load comes on in such a way as to have that current pass through both or but one of the current elements. To show the extent to which this simple but unreliable scheme may be in error, the true and apparent reactive component, power factor and total kva. have been computed for several combinations of non-inductive load and inductive load (Table I). It is evident that this scheme is unreliable to an extent that should materially restrict its application.

(c) *Two-Element Meter, Artificial Neutral.*—The potential coils in this scheme have voltages impressed upon them from a star connection built up of the two potential coils and a supplementary coil identical with them in impedance and power factor. The cross-phase connections are shown in Fig. 2.

The star voltage is only 63.6 when the line voltage is 110, and therefore a special watt-hour meter must be employed unless the voltage applied to the meters is boosted to 110 by auto-transformers or two-coil transformers.

This method is subject to the inherent error coming from cross-phase connections, but an additional adverse factor is the fact that even a slight displacement of the neutral arising from slight discrepancies among the three star impedances will result in a relatively large error in registration. The displacement of the neutral may be minimized by using two-coil transformers and connecting their secondaries in delta for application to the meter potential elements.

USING PHASING TRANSFORMERS

(d) *Two-Element Meter.*—Middle taps on two open-delta-connected potential transformers will make possible the application to the watt-hour meter (which is to be employed as a reactive meter) of potentials in quadrature with those applied to the corresponding elements of the power meter. Auto-transformers can be employed as in Fig. 3 to bring the voltage to the normal rated value for the meter. This method has the same inherent error under unbalanced conditions as all the other cross-connected schemes.

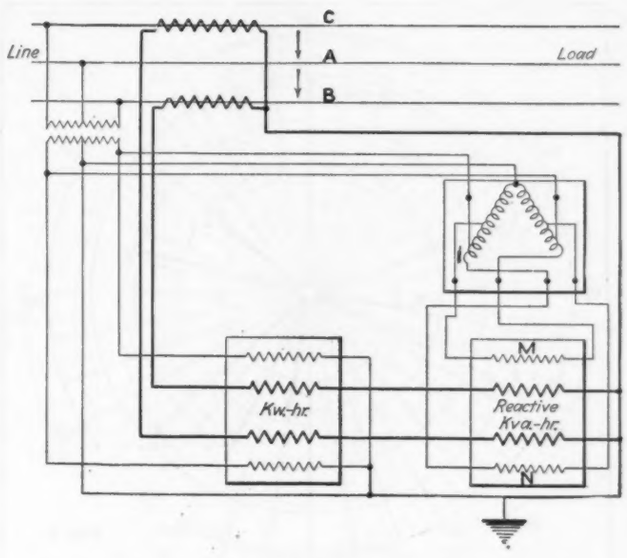
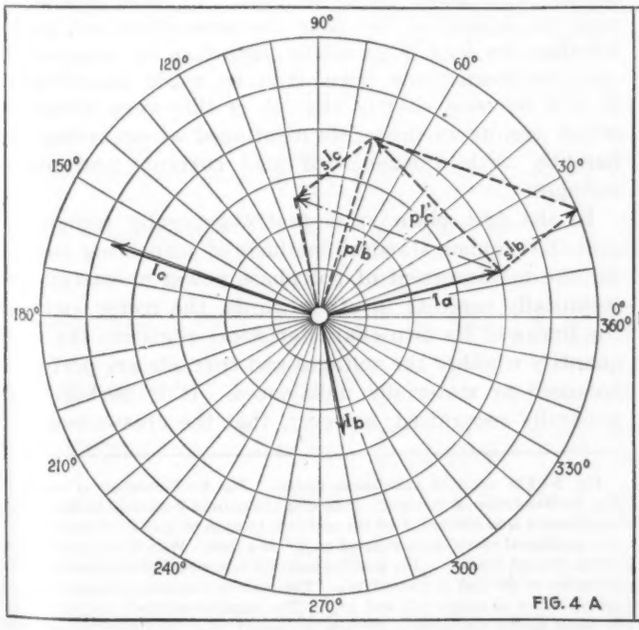


FIG. 3—PHASING TRANSFORMER PRODUCES ERROR

The use of phasing transformers introduces the same error as is inherent in all cross-connected schemes under unbalanced conditions.

To exhibit the degree of this error readings of various types of load were taken in the laboratory. The input in watts and volt-amperes was measured by single-phase instruments on each of the controlled single-phase loads; also by a polyphase wattmeter and a polyphase reactive meter connected in the three-phase line according to the open-delta potential connection of



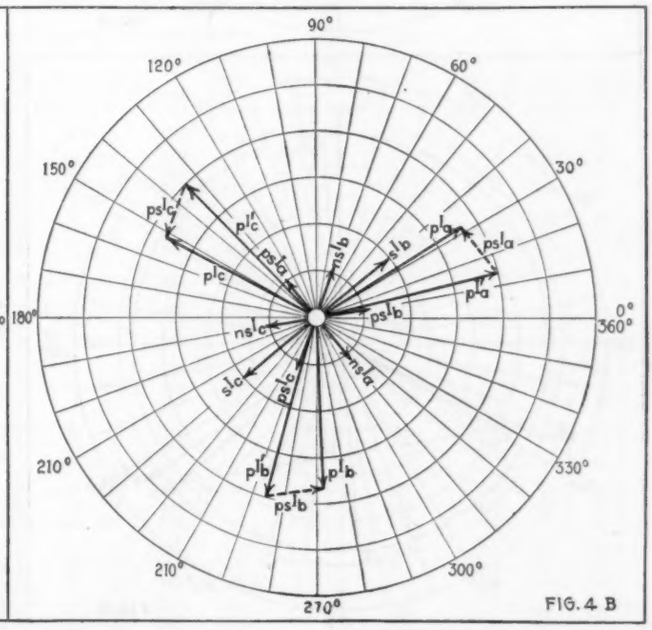


FIG. 4 (A) AND (B)—CROSS-CONNECTED REACTIVE METERING SCHEMES ARE NOT ACCURATE UNDER UNBALANCED CONDITIONS

(a) Vector analysis by resolving an unbalanced three-phase system into a balanced three-phase group of positive sequence and a single-phase current, after which (b) the single-phase current is resolved into two balanced systems of opposite phase sequence, and these are then added to form a single positive balanced system.

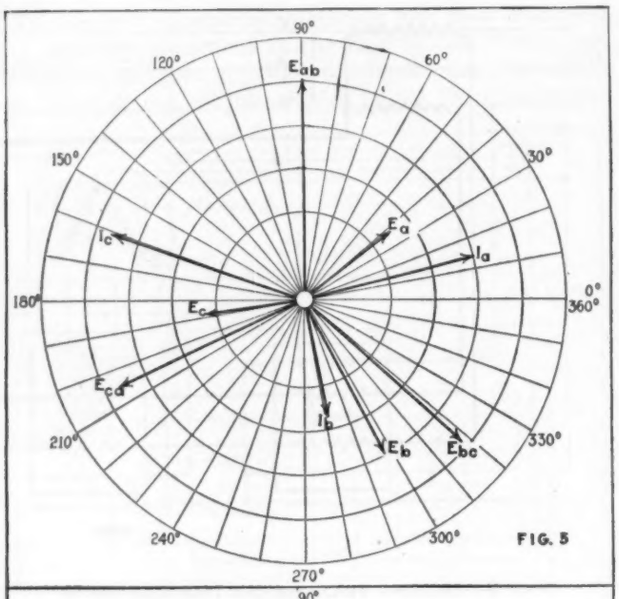


FIG. 5

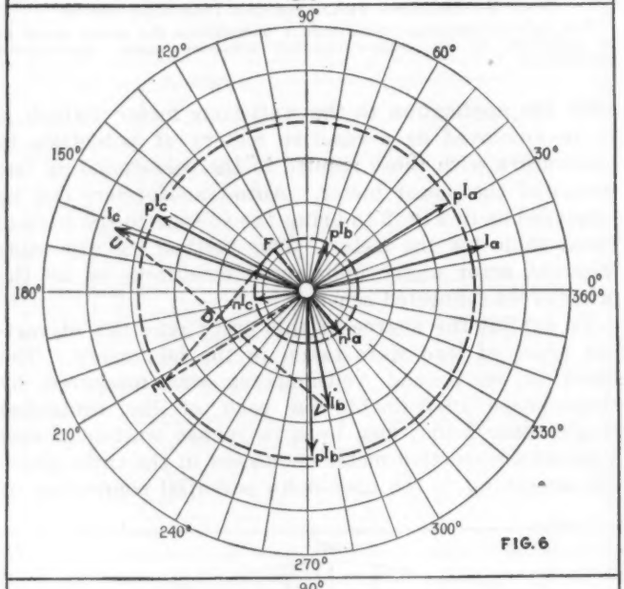


FIG. 6

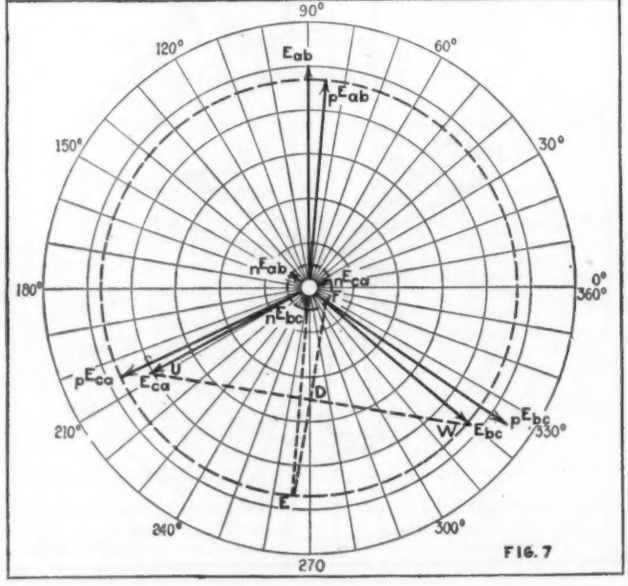


FIG. 7

FIGS. 5, 6 AND 7—RESOLUTION OF UNBALANCED THREE-PHASE SYSTEM BY PHASE-SEQUENCE METHOD DEVELOPED BY FORTESCUE

method (d), Fig. 3. The experimentally determined error differs slightly from the computed error because of slight meter errors and uncompensated losses in meters. The artificially imposed voltage unbalance, it will be noticed, in certain cases was made to agree in direction with what would result from line and winding impedances subjected to the unbalanced currents.

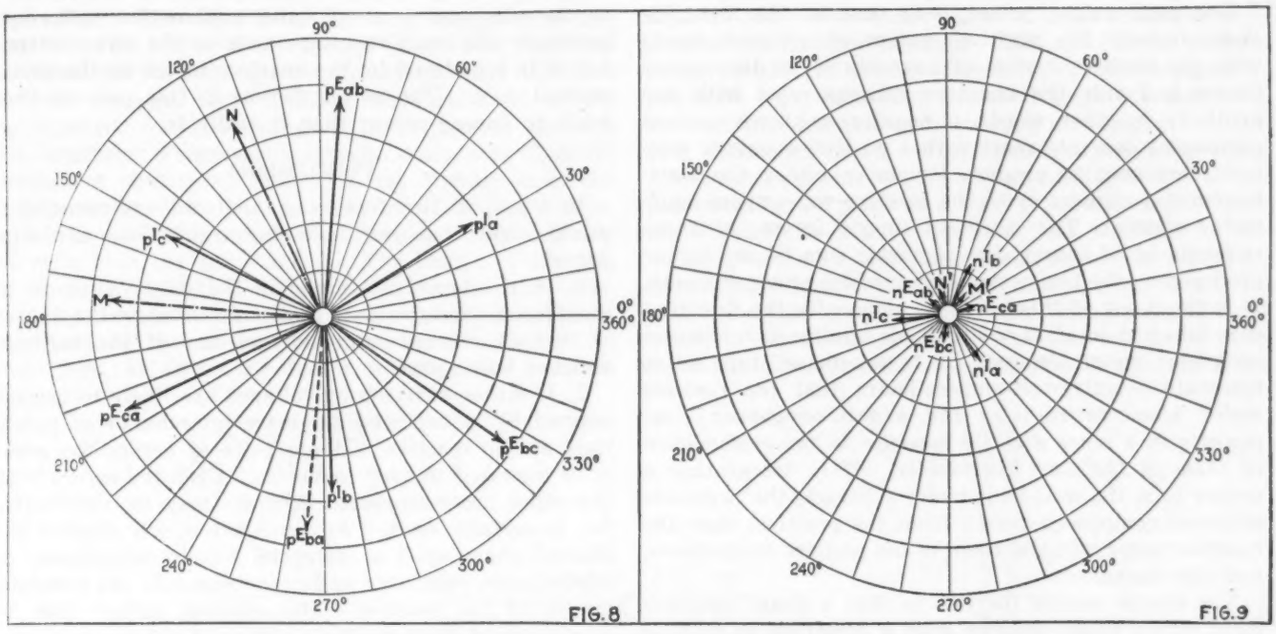
(e) *Three-Meter Elements, Delta Connection.*—Three single-phase meters or a three-element, three-phase meter may be used in a scheme similar to (b) and at the same time materially improve the reliability. Each element has applied to it a potential taken from two wires and its current from the third. The load side of one potential coil should be connected to the line side of the next, thus forming a closed delta, in order that the relative polarity of the elements shall be correct. Under certain conditions (unbalanced load of high power factor) one or more of the meters will be inclined to rotate backward. The registration of those meters will be short, because the light load compensation will work to add to the friction as a disk load instead of compensating for that friction. A three-element polyphase meter will obviate that difficulty. The elements as a whole will overregister the reactive component to an extent that requires the introduction of the multiplier 0.577. After this multiplier has been applied the registration will still be in error on unbalanced loads because that error is inherent with cross-connected schemes.

PHASE SEQUENCE MUST BE CONSIDERED

All of the above methods require that phase sequence be taken into account in making connections. The reason is, of course, that if the meter is to register "forward" instead of "backward" on an inductive load, the potential applied to it must lag 90 deg. from that applied to the corresponding element of a power meter. If the load is of a condensive character, "forward" registration would result only in case the applied potential is advanced 90 deg. in phase ahead of that applied to a power-meter element. In other words, it must be decided at the time the connections are made whether the load is primarily inductive or condensive, and the connections must then be made accordingly. It will be seen shortly that it is this very situation which results in the error mentioned as occurring inherently with unbalance of load currents and phase voltages.

In the first place, it is pretty generally recognized that the common standard methods of connecting meters for the measurement of polyphase power or energy are technically correct; in other words, the meter (within the limits of its own characteristics) registers the true quantity whether the voltages and currents are perfectly balanced or materially unbalanced. It is perhaps not generally recognized, however, that the cross-connected

Fig. 5—The assumed unbalanced system. Fig. 6—Resolution of currents. Fig. 7—Resolution of voltages. Following the current resolution in Fig. 6, the construction is as follows: Find the centroids (centers of gravity) *E* and *F* of the two equilateral triangles constructed on *UV* as a base. With *O* as a center draw circles through *E* and *F*. The positive sequence component of *Ia* is found as the extension of *EO* and is marked pI_a. The positive sequence components of I_b and I_c follow as shown (pI_b and pI_c). The negative sequence compont of I_a is found as the extension of *FO* and is marked nI_a. The negative sequence components of I_b and I_c are symmetrically placed with respect to nI_a, but the cyclic order is opposite to that of the assumed system of unbalanced currents o which they are components. It is readily seen that pI_a and nI_a combine to give the original I_a, and likewise for the components of I_b and I_c.



FIGS. 8 AND 9—VECTOR ANALYSIS FOR OBTAINING BASIS FOR TABLE II

Fig. 8—Positive-sequence components of system illustrated in Fig. 5 are obtained from Figs. 6 and 7, while in Fig. 9 the negative-sequence components are assembled.

reactive metering schemes are not similarly precise under conditions of unbalance. In analyzing this difference between power metering and reactive metering it is in many respects advantageous to resort to the principle that a system of unbalanced three-phase quantities can be resolved into two independent balanced systems which are of opposite phase sequence. One way of visualizing this principle is to assume such an unbalanced system of currents, separate them into a balanced three-phase group of positive sequence and a single-phase current; next resolve the single-phase current into two equal systems of balanced currents of opposite phase sequence; next add the two resulting positive balanced systems to form a single positive balanced system. The final result is therefore a positive and a negative system, each balanced. This process has been carried out in Fig. 4, where each step may be distinguished. The same system of currents is dealt with by another method of analysis, and the results will be seen to be the same. (Fig. 4 A and B.)

There is a method developed by Fortescue (see *A. I. E. E. Transactions*, 1918, page 1,114) which is more direct if less obvious, and this is employed in Figs. 5, 6 and 7 to demonstrate the errors cited.

TABLE III—EXPERIMENTAL DETERMINATION OF ERRORS IN METHOD (*d*)

(Using phasing transformers with connections as in Fig. 3.)

Type of Load	Single-Phase Loads: CA *E*	CA *I*	CA *W*	AB *E*	AB *I*	AB *W*	BC *E*	BC *I*	BC *W*	Total Watts	Total Volt-Amperes	Reactive Volt-Amperes	Polyphase Wattmeter Reading	Reactive Meter Reading	True Power Factor	Apparent Power Factor
Balanced non-inductive	99.7	3.74	374	107.9	3.85	410	101.1	3.93	395	1,179	1,190	....	1,192	2	100	100
Two-phase non-inductive	100.0	3.75	374	108.7	0	0	101.1	3.93	395	769	772	...	782	—5	100	100
	99.5	3.74	372	108.2	3.85	413	102.5	0	0	785	788	...	794	40	100	99.9
	100.8	0	0	108.0	3.84	412	101.8	3.95	400	812	817	...	824	—21	100	100
Single-phase non-inductive	99.3	3.72	369	112.9	0	0	109.8	0	0	369	369	...	370	13	100	99.9
	101.0	0	0	112.7	0	0	108.8	4.20	457	457	457	...	458	—50	100	99.4 ldg
	109.7	0	0	112.0	3.98	442	110.0	0	0	442	446	...	442	40	100	99.6
Balanced inductive	110.5	2.87	175	110.9	2.80	165	110.6	2.94	165	505	953	810	505	811	53.0	52.5
Two-phase inductive	100.0	2.60	144	109.7	0	0	102.5	2.72	143	287	539	456	283	480	53.2	50.8
	100.5	2.62	146	108.6	2.75	159	102.8	0	0	305	562	472	303	482	54.3	53.2
	101.0	0	0	109.3	2.75	162	102.0	2.70	140	302	575	489	303	467	52.4	54.4
Single-phase inductive	100.7	2.63	146	113.4	0	0	111.0	0	0	146	265	221	143	260	55.2	48.1
	100.7	0	0	113.9	0	0	109.8	2.91	160	160	320	277	162	243	50.0	55.5
	101.4	0	0	112.5	2.85	169	110.0	0	0	169	321	273	166	261	52.6	53.7
Single-phase inductive	100.7	2.63	1.46	113.4	0	0	111.0	0	0	146	265	221	143	260	55.2	48.1
	110.5	0	0	100.3	2.56	138	113.0	0	0	138	257	217	141	252	53.7	48.8
	10.85	0	0	107.4	0	0	99.5	2.65	135	135	264	227	127	253	51.1	44.9
Two-phase inductive	100.2	260	144	109.7	0	0	102.5	2.72	143	287	539	456	283	480	53.2	50.8
	102.3	2.67	151	101.4	2.91	194	113.0	0	0	345	568	451	345	488	60.8	57.7
	109.5	0	0	102.3	2.94	202	100.3	2.66	137	339	568	456	333	460	59.7	58.6
Single-phase non-inductive	99.3	3.72	369	112.9	0	0	108.8	0	0	369	369	...	370	13	100	99.9
	109.0	0	0	108.9	0	0	98.5	3.42	337	337	337	...	333	0	100	100
	109.5	0	0	98.2	3.53	346	110.5	0	0	346	346	...	343	0	100	100
Two-phase non-inductive	100.0	3.75	374	108.7	0	0	101.1	3.93	395	772	772	...	782	—5	100	100
	101.4	2.93	297	99.9	3.57	355	100.9	0	0	657	657	...	656	0	100	100
	109.0	0	0	101.1	3.59	363	100.5	3.48	350	713	713	...	717	0	100	100
Single-phase non-inductive 25 per cent unbalance	.....	....	...	.....	...	...	.....	....	...	.....	279	...	279	12	100	99.9
	108.9	0	0	87.7	3.18	276	113.0	0	0	276	426	...	424	75	100	98.5
	110.1	0	0	89.5	0	0	111.5	3.82	425	425	.....	...	.....	....	.....	....

The next ruling principle is that in the metering elements only the positive system of voltages reacts with the positive system of currents to produce meter torque and only the negative systems react with one another; in other words, a negative-sequence current component does not react with a positive-sequence voltage component to produce torque in either the watt-hour-meter element or in the reactive-volt-ampere-hour-meter element. The resultant torque in one of these elements is, of course, the algebraic sum of the torque produced by the two systems of opposite phase sequence. It is the point of this paper to emphasize the fact that it is inherent in all of the methods aiming so to connect watt-hour meter elements by "cross-phase" taps as to integrate reactive-volt-ampere-hours that *the reactive meter elements register the negative-sequence components in a sense directly opposite to the registration of them in the watt-hour meter.* If in integrating a proper total the watt-hour meter subtracts the negative-sequence component power from the positive, then the reactive meter will add them to the positive components, and vice versa.

The simple reason for this is that a phase displacement which takes place in such a direction as to be a lead for the positive-sequence system will inherently be a lag for the negative-sequence system. In metering the reactive component of an inductive load the potentials applied to the meter will have to lag behind those applied to the corresponding element of the power meter. This lag is, of course, referred to the original system, and this system was conventionally called a positive-sequence system. But the unbalance, if any, can be attributed to a negative-sequence component and what was lag for the positive will be lead for the negative. The very meter which was installed to register the lagging component will therefore tend to record it in the wrong sense. The negative-sequence component, incidentally, can be taken as the measure of the unbalance.

Assemble in one diagram (Fig. 8) the positive-sequence components of the originally assumed unbalanced system of voltages and the corresponding positive-sequence current components, from Figs. 6 and 7 respectively; and assemble in a second diagram (Fig. 9) the negative-sequence current and voltage components.

If the voltage $p^E a$ and current $p^I a$ are applied to the upper element of the watt-hour meter, and also if the connections of Fig. 3 are employed for the reactive meter, then voltage and current for the upper element of the reactive meter will be M and $p^I a$ respectively; for the lower reactive element they will be N and $p^I b$, respectively. The corresponding negative-sequence components of these quantities will produce total torque in the watt-hour meter in the direction opposite to the positives; in the reactive meter, however, the negative-sequence components of currents and voltages will react to produce total torque the same in direction as that produced by the positive-sequence components. The signs of these torques have been determined from the vector diagrams (Figs. 8 and 9) and arranged in Table II. The registration of the reactive meter is, therefore, in error to an extent determined by twice the magnitude of the torque of the negative-sequence components.

In this case the true power is the algebraic sum (and arithmetical difference) of the powers in the two systems. The true reactive component should similarly be the algebraic sum of (and arithmetical difference between) the reactive components in the two systems, but it is registered by the reactive meter as the arithmetical sum. The power factor in this case is thus made to appear poorer than it really is.

CONCLUSIONS

In view of the foregoing analysis and results it would seem that the following conclusions are supported:

1. If freedom from error is the only factor to be considered, then for loads that will remain well balanced as to both currents and voltages any of the methods outlined will suffice.

2. If either currents or voltages are likely to become appreciably unbalanced, the mere interchange of potentials at the reactive meter results in errors too great to be tolerated in most instances. Even the errors with the other cross-connected schemes may be prohibitive for important loads. Any method which obtains the desired phase shift of potential flux by adjustment of conductance, reactance and condensance in the potential circuit of the reactive meter element rather than by admixture of line potentials will avoid the error.

3. If, however, the cost of meters, the cost of meter administration and the proficiency of metermen in installing, reading and testing meters are to be given due consideration along with the accuracy of registration, there is a question whether any—except method (b)—of the methods outlined can be wholly condemned as too inaccurate for use with the majority of loads.

4. The situation seems to point to the desirability of developing a reactive metering scheme which will be more generally precise for large and important loads than those now commonly employed.

Coal Handling at Zilwaukee

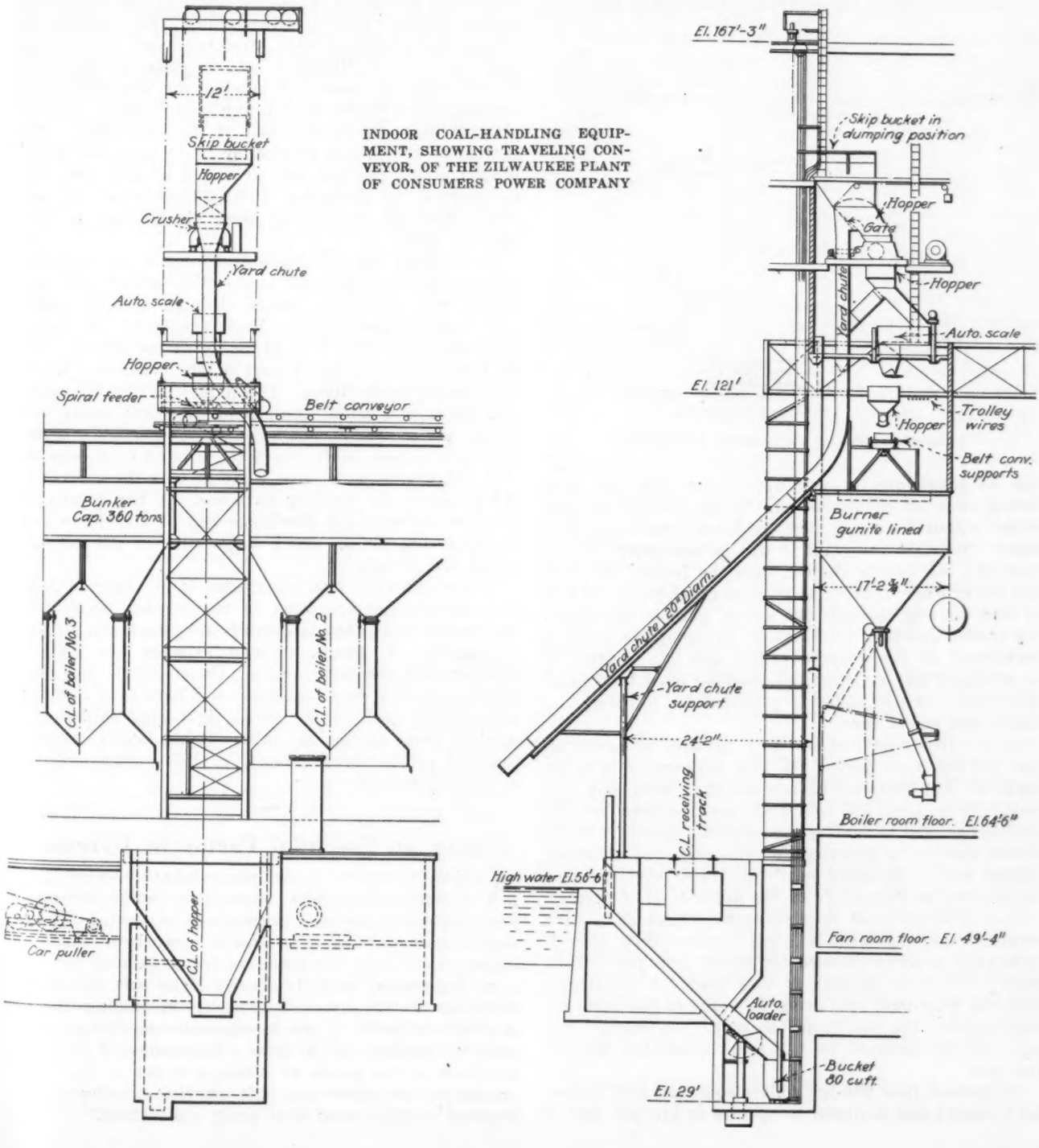
Avoidance of Great Investment and Costly Attendance Governed the Selection and Arrangement of Coal-Handling Equipment

BY H. F. EDDY
Mechanical Engineer Consumers' Power Company, Jackson, Mich.

A RATHER unusual system for handling coal and ash has been employed by the Consumers' Power Company in its new Zilwaukee steam generating station on the Saginaw River. The design was influenced chiefly by the desire to handle all coal during the daytime, including coal for storage, and by the fact that there are large areas on the property to be filled which can be utilized for disposal of ashes for several years to come. All of the equipment was selected with a view to minimizing the amount of labor required and to insure reliable continuous operation without great investment or skilled operators to run complicated machinery.

Coal is received in drop-bottom cars on an elevated track next to the boiler room and is dropped through the trestle into a concrete pit, which delivers its contents to a skip bucket loader that fills automatically. This loader elevates the coal 125 ft. in an 80-cu.ft. bucket to a hopper, from which coal can be delivered either to the overhead bunkers through a coal crusher and an automatic scale or to a spout that leads to the yard storage system. From the crusher the coal can

be delivered to the automatic scale or to the yard storage spout. The scale is intended to weigh only coal that is to be delivered to the coal bunkers so that coal intended for yard storage can be crushed and delivered to yard storage, or if crushed when received, it can be delivered to yard storage without passing through the crusher. From the automatic scale coal is delivered to a shuttle-belt conveyor set directly over the coal bunkers. This belt is mounted on a steel frame, which in turn is supported on flanged rollers running on rails over the boiler house. The length of the belt is about one-half that of the boiler house. The scale, which is of the automatic drop type, delivers 1,000 lb. per drop, so that in order to give the shuttle belt an even feed, an automatic feeder is interposed between the automatic scale and the shuttle belt. This feeder consists of a screw conveyor with steep sides but with part of the bottom omitted. The belt on the shuttle conveyor and the frame supporting it are arranged to run both right-hand and left-hand from the center of the building, and coal is discharged over one end of the belt. While the coal is being discharged, the supporting frame moves from one side of the building to the other, thus moving the point of discharge of the coal. When the end of the frame that was near the end of the building reaches a point near the center of the building, it is automatically stopped. If it is desired to fill the bunkers on the opposite side of the center from that on which it was working, the direction of travel for both the belt and the frame is reversed and the operation



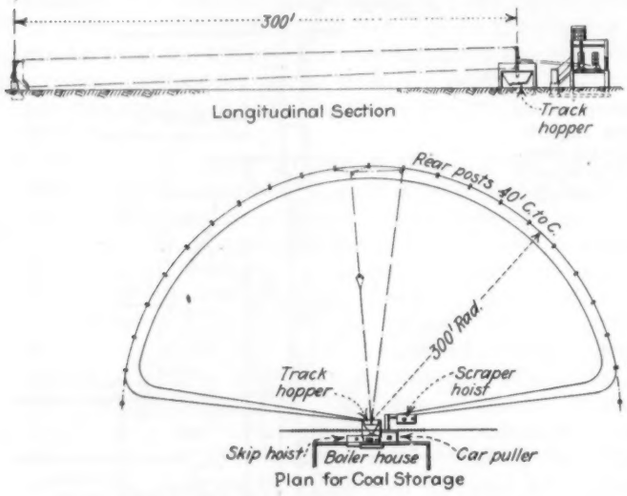
INDOOR COAL-HANDLING EQUIPMENT, SHOWING TRAVELING CONVEYOR, OF THE ZILWAUKEE PLANT OF CONSUMERS POWER COMPANY

continued as before. If desired, the shuttle belt can be set stationary over any point for filling a single bunker.

There is a coal bunker for each boiler made of steel plate tied into the building steel. These are of inverted pyramidal forms and are self-cleaning and lined with 1½-in. Gunite on wire mesh. Each bunker has a capacity of 350 tons, and two outlets are provided for each boiler, fitted with 16-in. cast-iron rack-and-pinion gates operable from the boiler-room level.

The stoker spouts are of steel with flared ends, which facilitate the mixing of the coal before delivery to the stokers and permit the flow of the coal to be seen at all times by the boiler-room attendant. The spouts are pivoted at the top so that they may be swung out through a window in case of fire in the bunkers. The equipment is designed to handle 60 tons per hour.

The various units are electrically interlocked so that in



YARD STORAGE AND RECLAIMING FACILITIES

case of breakdown of any unit, or in case any unit should stop, all equipment that feeds coal to the unit which is shut down will stop. Sequence starting is provided. To start the plant it will be necessary first to start the belt on the shuttle, then the feeder, the scale and the crusher, if the coal is to be crushed; or, if not, to feed the coal through the proper gate in the spouting system and then to the skip. Stopping the plant is performed in the reverse order, and the control is so arranged that starting and stopping must be done in this order. A car puller is provided for handling the loaded and empty cars.

As previously pointed out, it is intended to handle all coal for the plant during the day, arrangements being made so that this can be accomplished with only two men. These men will spot and open the cars, set the shuttle belt and look after the overhead system. Push-button control is provided for the skip and overhead system and is installed near the track level, but the system can be stopped from the upper level if desired.

Coal is distributed to storage by means of a yard scraper equipped with a ¾-yd. crescent-type bucket. This yard provides storage for 35,000 tons piled 12 ft. deep. The yard scraper is also used for reclaiming coal, the reclaimed fuel being delivered to the same pit that receives the coal from the cars. The storage system will be operated by the same crew that handles the cars.

At present four 930-hp. boilers equipped with underfeed stokers and designed to operate at 540 per cent of rating are installed. When operating at this rating these boilers will require approximately 400 tons of coal per day. When four additional boilers are installed an automatic car dumper and a double skip with necessary crushers and weighing equipment may be provided. The future skips and their auxiliary equipment may feed a shuttle belt, and the present and future skips may be interconnected by a reversible belt conveyor. When the future units are installed the present skip may be used only for handling storage coal.

Clinker crushers are provided under each stoker which will break the clinkers down to about 2 in. The ash pits are made of steel frames attached to the steel girders supporting the stokers. The space between the frames is filled with concrete applied with a cement gun, and the entire inside surface of the ash pits is lined with a mixture of ground firebrick and refractory cement applied with a cement gun. The concrete inclosure is reinforced with steel bars and wire mesh, and the firebrick lining is held in place by wires set in the concrete walls. Provision for expansion and contraction of the firebrick lining is provided by leaving about ½ in. space at each end of the long walls. The bottom of the pits is formed by heavy cast-iron gates hinged across the pits and arranged so that they can be dropped by operating a large handwheel on one side. Slots in these gates allow air to pass up into the ash pits.

To simplify the ash disposal problem a semi-circular concrete flume 3 ft. wide is provided under each row of ash pits and water forced through it when ashes are being dumped. Under these conditions the water is maintained within 6 in. of the top of the flumes. For flushing out the ashes a part of the condenser water is diverted to the flume. The flumes deliver the ashes and water to a pit at one end of the plant where two dredge pumps, one of which is a spare, raise the mixture to a point about 20 ft. above the ground level, whence it is distributed by wooden launders over the surrounding property for grading purposes. A bar grizzly is provided between the discharge end of the flume and the receiving pit on which large clinkers can be collected and broken up.

Under ordinary load conditions it is expected that the ash-handling operation in twenty-four hours will not require more than ten man-hours. Each ash pit has a capacity of about 10 tons between the clinker grinders and the dump gates. Under heavy load conditions and with poor coal, ashes will have to be dumped once during each of the three eight-hour shifts, and possibly twice on the day shift. It has been estimated that the ash-handling capacity of this system will be at least 25 tons per hour.

Power an Essential Factor in Defense

A POWER survey to determine what resources are available and by what means they can be increased when necessary for war purposes is, according to Assistant Secretary of War Davis, a work of extreme importance. Such a survey is being carried out by army engineers. Said Mr. Davis: "The part played by electricity in the great war was but an inkling of the possibilities which it can demonstrate should the need arise for another call to arms. Knowledge of the vast resources in the hands of America is one of the best arguments for peace—and it is one that a belligerently disposed country could most easily understand."

Reproduction and Investment Costs as Rate Bases*

Effe ctof Price Trends Upon Each—Reproduction Cost Cannot Be Ignored Whether Greater or Less than Investment Cost—Commissions Still Adhere to Investment as Basis of Return

By L. R. NASH
Stone & Webster, Inc., Boston, Mass.

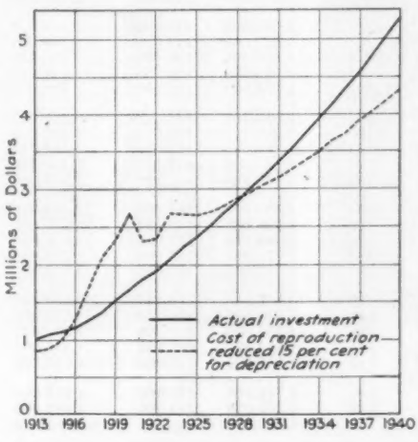
IT IS not without significance that increasing recognition is being given to the present cost of reproduction as a rate base, in view of the attitude of the courts, to which rate cases are appealed. Obviously, when seeking the protection of the courts, the methods which they adopt must be followed whether or not they appear most appropriate under existing circumstances.

In spite of the unbroken line of court decisions so far on record on this subject, it does not necessarily follow that some change with respect to public utilities may not some time be made because of special regulatory practices affecting them but not other industries subject to competitive influences. The recent Southwestern Bell Telephone case occasioned a sharp division among the justices, disclosed in a dissenting opinion which presented in an able and forceful manner the advantages of prudent investment as a rate base. Although this basis was rejected in that case and in more recent Supreme Court cases, the actual recognition given in leading cases to present cost of reproduction as compared with investment has not been wholly encouraging up to this time. In no decision of last resort has present cost of reproduction been the sole measure of value, and in many cases fair value has been so scaled down by averaging unit prices over a period of years, or by deductions for depreciation, or both, that the final finding of value has been but slightly higher than actual investment.

COMMISSIONS FAVOR PRUDENT INVESTMENT BASE

Regulatory commissions are still more strongly inclined to adhere to investment as the basis of return in rate cases. It is possible that a sufficient number of further decisions of our leading courts reversing this practice of the commissions would lead to their general adoption of the reproduction method as controlling. This process, however, would require a considerable period of years, during which, it is to be expected, there will be some decline from the present level of prices to a level much below the maximum prevailing in the post-war period, during which a large amount of public utility construction was necessary. If a few years hence construction prices have fallen to a level 50 per cent above the pre-war level, they will still be at least 33⅓ per cent below the peak prices prevailing in 1920. It is therefore conceivable that actual investment may not only approach consistency with reproduction cost, but that it may materially exceed it after a period of years. A strict adherence to cost of reproduction might, therefore, in time work to the disadvantage of at least some utilities and holders of their securities.

It is of interest to make certain assumptions as to the future level of prices affecting public utility properties and the growth of these properties to determine when, if at all, the cost-of-reproduction method will cease to yield a value higher than the actual investment. For this purpose a public utility has been assumed having, in 1913, 10,000 units of property, each with a value of $100 and, therefore, representing a total value (assumed to coincide with investment) of $1,000,000. It is further assumed that each year there is added to the property a number of similar units equal to 5 per cent of those then existing. Such an assumption is not inconsistent with the history of progressive public utilities. There has next been determined, as accurately as possible, the weighted average prices of public utility units such as those assumed in each of the years since 1913, and estimates have been made as closely as possible of the future movements of these prices.



The prices of material entering into public utility properties are now substantially higher than the average of all commodities. While the reasons for the discrepancy will in part continue, it is to be expected that there will be some tendency toward greater consistency within the next few years, after which, it is assumed, a decline in public utility and other prices will continue at about the same rate as the increase which occurred during the period from 1896 to 1913 and the decrease during the preceding period, which began about 1878. The rate of change in these periods was about 2 per cent per annum. It may appear inconsistent to assume a reduction in public utility construction costs continuing after they have come into accord with general prices, but such reduction is, nevertheless, anticipated by many well-informed people, and it is at least permissible to determine the results of such possible reduction.

The above assumptions are all embodied in an accompanying table which shows for a series of years from

*From a discussion of the 1923 report of the American Electric Railway Association valuation committee.

1913 to 1940 the number of units in the property, the current costs of these units and the actual investment, starting at $1,000,000 and increasing from year to year by the current costs of the added units. There has then been computed the cost of reproduction of the entire existing units in each year at the prices then prevailing. The figures shown are not exact, being obtained by slide-rule computations.

An examination of the columns of total investment and cost of reproduction shows a steady increase in the former but a far less regular change in the latter. The cost of reproduction increases rapidly up to 1920, after which there is an actual decline in spite of the annual

PUBLIC UTILITY VALUATION—RELATION OF COST OF REPRODUCTION TO INVESTMENT

(5 per cent increase in property units per annum)

	Units		Current	Investment		
Year	Total	Annual Additions	Unit Costs	Total	Annual Additions	Cost of Reproduction
1913	10,000	500	$100	$1,000,000	$49,000	$1,000,000
1914	10,500	525	98	1,049,000	56,000	1,029,000
1915	11,025	550	107	1,105,000	72,000	1,180,000
1916	11,575	580	130	1,177,000	96,000	1,505,000
1917	12,155	605	165	1,273,000	118,000	2,006,000
1918	12,760	640	195	1,391,000	131,000	2,488,000
1919	13,400	670	205	1,522,000	151,000	2,748,000
1920	14,070	705	225	1,673,000	131,000	3,166,000
1921	14,755	740	185	1,804,000	133,000	2,734,000
1922	15,515	775	180	1,937,000	151,000	2,794,000
1923	16,290	815	195	2,088,000	151,000	3,178,000
1924	17,105	855	185	2,239,000	150,000	3,165,000
1925	17,960	895	175	2,389,000	152,000	3,144,000
1926	18,855	945	170	2,541,000	157,000	3,206,000
1927	19,800	990	166	2,698,000	161,000	3,287,000
1928	20,890	1,045	163	2,859,000	167,000	3,405,000
1929	21,935	1,095	160	3,026,000	172,000	3,510,000
1930	23,030	1,150	157	3,198,000	177,000	3,616,000
1931	24,180	1,210	154	3,375,000	184,000	3,723,000
1932	25,390	1,270	152	3,559,000	191,000	3,859,000
1933	26,660	1,335	150	3,750,000	198,000	3,999,000
1934	27,995	1,400	148	3,948,000	204,000	4,143,000
1935	29,395	1,470	146	4,152,000	212,000	4,291,000
1936	30,865	1,545	144	4,364,000	219,000	4,444,000
1937	32,410	1,620	142	4,583,000	227,000	4,600,000
1938	34,030	1,700	140	4,810,000	235,000	4,764,000
1939	35,730	1,790	138	5,045,000	243,000	4,940,000
1940	37,520	.....	136	5,288,000	.....	5,103,000

increase in number of property units, which decline is not overcome for several years. It appears that in 1938 the investment begins to exceed the cost of reproduction, the excess increasing from year to year. It follows under the assumptions made that if public utilities, either voluntarily or through unreversed regulatory action, are limited to return on the investment for the next fifteen years, it would thereafter be to their advantage to have this basis of value continue instead of changing to cost of reproduction.

If other assumptions are made as to rate of growth or the trend of future prices, different comparative results would be obtained. It goes without saying that a property without any growth since 1913 would continue to gain advantage through the cost-of-reproduction method as long as current prices remained higher than those prevailing in 1913. On the other hand, if the rate of growth was more rapid than that assumed in the accompanying table, the investment would overtake the cost of reproduction at an earlier date. If, for example, the property units increased at the rate of 10 per cent per annum instead of 5 per cent, the investment would exceed the cost of reproduction within ten years.

If the prices of public utility materials fail to decline materially during the coming years, the investment would not equal cost of reproduction until a later date, if at all, depending upon the trend of prices. If, on the other hand, the decline is sharper than that assumed, the investment would overtake the cost of reproduction more promptly. Computations in which prices are assumed to have fallen to 150 in 1930 instead of 1933, as in the accompanying table, show investment overtaking cost of reproduction within ten years from now instead of fifteen years.

The uniformity in rate of growth assumed in the table does not represent the facts, particularly during the period of most rapid price fluctuations. Prior to and during our participation in the world war there was an enforced curtailment of construction except where required for war purposes. During the following years of continued business activity and also of maximum commodity prices it was necessary for many public utilities to undertake an exceptionally large amount of construction, and so the effect of peak prices upon investment becomes more pronounced than under the assumptions of a uniform growth. It follows that under such circumstances investment will overtake reproduction cost at an earlier date.

It is to be noted also that no deductions have been made for accrued depreciation from any of the figures compared in the accompanying table. A study of rate decisions shows very few cases where deductions have been made from investment for depreciation, but a comparatively large number in which such deductions are made when the reproduction method is used in determining value. If, therefore, it is assumed that cost-of-reproduction figures are generally subject to such deductions and actual costs are not, there is a further tendency for investment to show an earlier advantage. Actual investment overtakes the cost of reproduction, shown in the table, in 1929 if the latter is reduced by 15 per cent for depreciation.

Investment Cost Gaining with Time

It would not be unreasonable, in the light of the above data, to predict that with only partial recognition of present cost of reproduction, which still prevails, and the deductions for depreciation which may be made because of such recognition, this basis of value will yield higher results than actual investment during only a few more years, after which its exclusive use would not be advantageous even if permissible. This discussion, with its accompanying data, is not presented for the purpose of discouraging reasonable attention to cost of reproduction, but to point out that investment should not be ignored. The A. E. R. A. committee report recommends that both these evidences of value should always be presented in rate cases, as has been the general practice in the past. Before the war the simplicity of the investment basis, which did not differ radically from cost of reproduction, had its appeal to both utilities and commissions. During and following the war departure from this basis was necessary to maintain the credit or solvency of many companies. A rate of return within the limits which the commissions felt free to authorize would not, when applied to investment, yield a return attractive to new capital. Other companies, however, passed through the war period with satisfactory rate adjustments without claims for value higher than investment. With return to more stable economic conditions this basis should show increasingly favorable results, but, as the valuation report points out, cost of reproduction cannot safely be ignored whether it be greater or less than the investment in the property.

System Maintenance and Inspection

Periodical Inspections and a Maintenance Crew Reduce Service Interruptions—Details of Organization Equipment and Duties on a Transmission and Distribution System

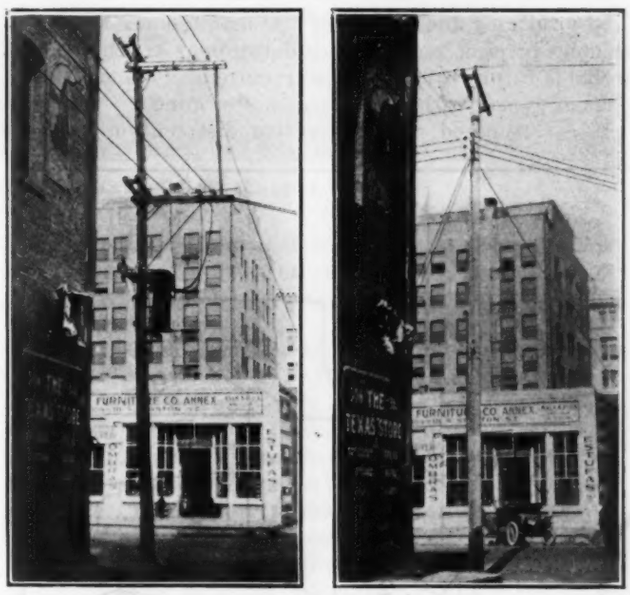
By JAMES E. JORDAN
Superintendent of Distribution El Paso Electric Railway

EARLY in 1922 a decided innovation was made in connection with the El Paso Electric Railway Company's light and power distribution and transmission systems by putting into effect a maintenance schedule calling for periodic inspection and repairs.

For this purpose the territory served by the company's lines was divided into twelve sections, El Paso being divided into eleven sections, with Juarez, across the Rio Grande, in Mexico, comprising the twelfth section. The blocks in each section are numbered in consecutive order, as are the sections themselves. Work is done starting with Section 1, Block 1, and following through each block in order. The sectional divisions are designated on a large map of the territory served by the company's lines, one map being kept by the distribution engineer and another by the foreman in charge of the maintenance crew. The size of these sectional divisions is governed by the density of the lines rather than by any geographical factors that might enter into the problem.

INVESTIGATION NECESSARY

Prior to starting work on any section, the section is thoroughly gone over by the superintendent of distribution, general line foreman and distribution engineer, any changes or replacements are definitely outlined, and photographs are taken of existing conditions. Work by the maintenance crew, consisting of a foreman, four linemen and three helpers, is then commenced according to the changes outlined by the general line foreman. A light line truck is allotted to this maintenance crew and is kept with that crew on maintenance work entirely.



IMPROVING THE APPEARANCE OF A STREET CORNER BY UP-TO-DATE CONSTRUCTION

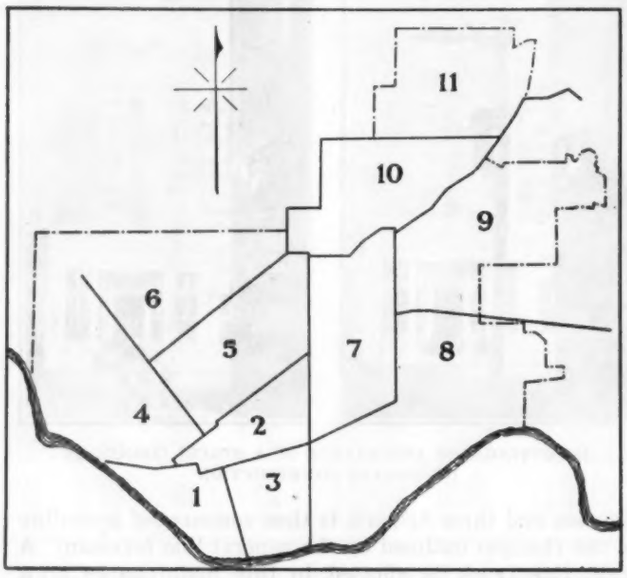
CHANGING THE APPEARANCE OF A STREET CORNER
Left—Old installation on southeast corner. Center—Corner after pole was removed. Right—New installation on northeast corner

The scope of work done by the maintenance crew embraces in general the following:

1. Standardizing construction in so far as possible.
2. Pulling slack out of wires.
3. Removing unnecessary copper.
4. Removing unnecessary poles and cross-arms.
5. Straightening poles and replacing bad ones.
6. Rearranging services and renewing those in bad condition.
7. Replacing bad cross-arms.
8. Relocating transformers.
9. Improving customers' voltage.
10. Checking transformer loads.
11. Filtering transformer oil.
12. Cleaning and repairing transformers.

In preparing the details of the maintenance work to be done in each section, consideration is taken of the probable future expansion and requirements, and alterations are made with such expansion in mind.

It is estimated that the entire distribution system



FOR MAINTENANCE PURPOSES THE CITY IS DIVIDED INTO SECTIONS

can be gone over in two years. On a pro rata basis, therefore, two months is allotted to each section in which to complete the maintenance work.

The actual work done by the maintenance crew proper consists primarily of the first ten items enumerated above. After this crew has completed the work on a section, a second or "follow-up" crew, consisting of two men and a helper, goes over the section, inspecting, cleaning and filtering oil in distribution transformers. Any transformer showing evidence of any defect is at once replaced and the faulty transformer brought into the shop, where it is thoroughly tested and overhauled. After repairing, the transformer is again subjected to virtually the same tests as it received in the factory.

As the maintenance crew continues its work through a section, close touch is kept with this crew by the general line foreman, and as the section is completed a thorough inspection of the section is made by the superintendent of distribution, general line foreman and distribution engineer. As the task is finished kodak pictures are taken of the completed work. These, together with those taken before the work was started, give a very accurate idea of the changes which have taken place.

Jan. 16, 1923.

Block 25
Cross-armed two poles.
Removed cross-arms from two poles.

Block 26
Cross-armed three poles.
Removed cross-arms from one pole.
Changed drop wires on one street light.
Removed one transformer.
Changed service wires to 404 South Campbell Street.

Block 27
Removed cross-arms from four poles.
Removed two 30-ft. poles.
Reset one 35-ft. pole.

Jan. 17, 1923.

Block 27
Removed cross-arms from five poles.
Cross-armed two poles.
Put two-wire racks on one pole.
Transferred grounded wire and conduits to new pole.

Block 28
Cross-armed six poles.
Removed cross-arms from four poles.
Moved one transformer.
Guyed one pole.
Transferred two trolley spans to new pole.
Put up two No. 2 wires in two spans of primaries.
Removed two No. 2 wires in two spans of primaries.
Changed five No. 6 wires in two spans of primaries.

Jan. 18, 1923.

Block 27
Removed one 35-ft. pole.
Pulled slack in lighting primaries and secondaries.
Changed service feeding 416 South Campbell Street.

Block 28
Removed one 35-ft. pole.
Removed cross-arms from one pole.
Put three-wire rack on one pole.
Pulled slack in power primaries and lighting primaries and secondaries.
Guyed one pole.
Transferred one trolley span wire.

Lard Refining Substation

Date.....

3. Substations—Monthly.
General inspection of substation, including structure and buildings. Inspection for broken insulators, etc. General appearance.
General appearance good.
No broken insulators.
Cleaned station and transformers.

4. Transformers—Monthly.
Cleaning and inspecting of transformer bushings. Quantity of oil. Temperature of transformers. Inspection for loose connections.
Cleaned transformer bushings.
Plenty of oil. Temperature, 32 deg., 33 deg., 30 deg.
No loose connections.

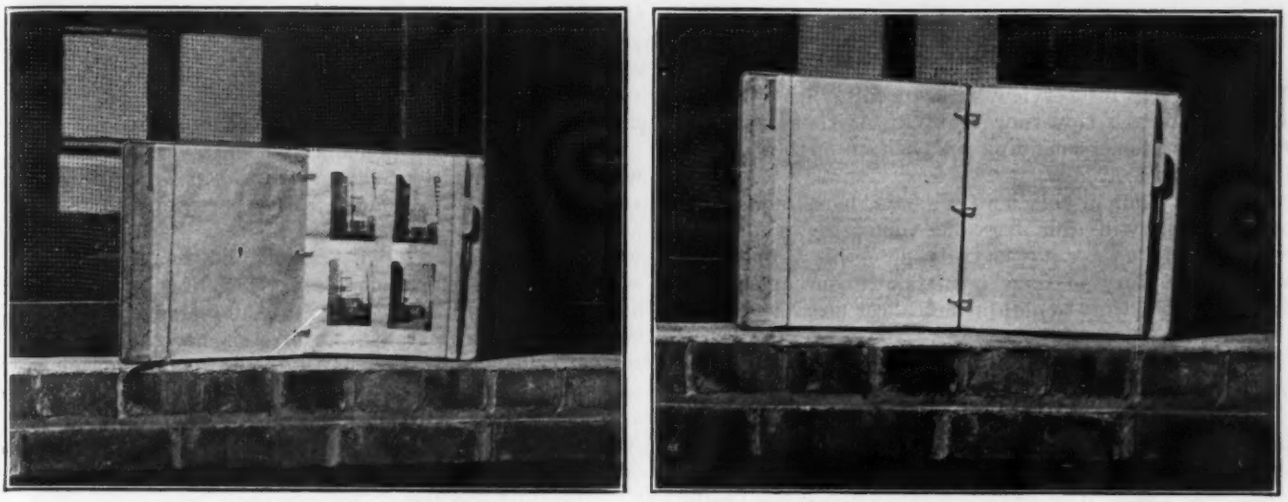
6. Oxide-Film Lightning Arresters—Monthly.
General inspection for loose connections, etc. Test for bad cells (after electrical storms).
No loose connections.
Tested all cells—found O.K.

9. Grounds—Monthly.
Condition of ground wires. Inspection for loose connections.
Ground connections O.K.
Ground test to water pipe, 34 volts, 8.3 amp.

10. High-Tension Switching Equipment—Monthly.
Inspection for loose connections and defective insulators. Amount of liquid in carbon-tetrachloride fuses. Number of spare fuses. Condition of switch stick.
No broken insulators.
No loose connections.
Fuses O.K.
Three spare 30-amp. link fuses.
Switch stick O.K.

A TYPICAL SUBSTATION REPORT

The records kept in connection with the maintenance work are as simple and yet as complete as possible. Each day the foreman in charge of the maintenance crew hands to the general line foreman an account of the work done for the day and the section and block numbers in which the work is done. This record is written up and filed in a loose-leaf book in the manner shown by the accompanying sheet. In this book is also kept a photographic record of the work done, showing the different locations before and after the changes have been made.



BOTH WRITTEN AND PICTORIAL DAILY RECORDS ARE KEPT ON MAINTENANCE WORK

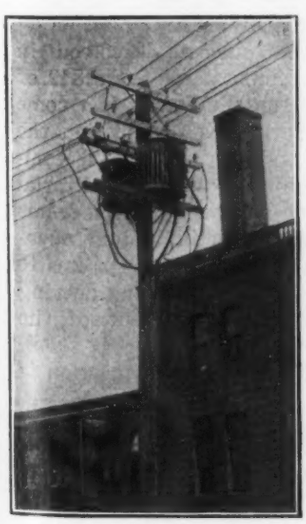
The above discussion applies to the maintenance schedule in operation on the distribution system. A similar schedule is carried out on the substations and transmission lines. The transmission lines within the city limits are patrolled daily, with a thorough inspection on the first and fifteenth of each month, the line extending from El Paso to Ysleta, Tex., 12 miles distant, being patrolled and inspected the first of each month.

All substations, of which there are thirteen, receive a thorough inspection and repairs once each month. This inspection covers the general appearance of the substation, condition of the transformer bushings, quantity and temperature of transformer oil, condition of lightning arresters, condition of ground connections, with a ground test, and condition of high-tension switching equipment, number of spare fuses, quantity of liquid in carbon tetrachloride fuses, etc. In addition to the above inspection, transformer oil is filtered every two years, lightning arresters are overhauled yearly, oil in oil switches is filtered yearly, and all high-tension pole-top switches are inspected and overhauled semi-annually.

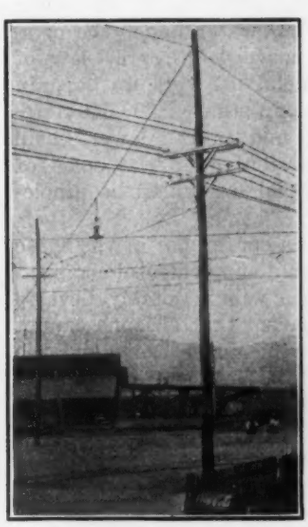
The substation maintenance crew is furnished with neostyled forms showing the inspections to be made at the time. This form is filled out by the foreman in charge of the crew and after being transferred to the permanent record book is filed for reference. Ornamental street lights are also inspected and overhauled every four months.

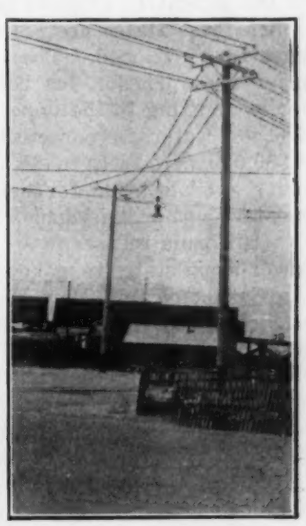
Since the inauguration of the maintenance schedule in connection with the distribution and transmission systems, the interruptions to service due to line troubles have been very greatly reduced and a great saving in cost of line maintenance has also been accomplished. In direct contrast to the sections which have not been gone over, no serious trouble has been experienced in those sections which have been reworked. As the schedule has been in operation for a very short while, there is considerable deferred maintenance which has to be done the first time through each section. The amount of work will be greatly reduced at the next period. The institution of such a schedule will, therefore, not only decrease the number of line failures but will also decrease the cost incident to maintenance of the transmission and distribution systems.

Taken as a whole, the results obtained are very satisfactory indeed and prove to the company's satisfaction that the best operation of the transmission and distribution systems can be had only as a result of systematic maintenance and inspection.



SHOWING WHAT CAN BE DONE WITH TRANSFORMER MOUNTING





A BEFORE-AND-AFTER VIEW OF AN ALLEY AND STREET INTERSECTION

Governor of Arizona States His Stand on Colorado River Situation

IN A RECENT interview with an editor of the ELECTRICAL WORLD Governor Hunt of Arizona made the following statement defining his position on the Colorado River compact:

"The decision in this matter is the most momentous one Arizona will ever be called upon to make. Her whole future as a state is tied up to this proposition. We cannot afford to make a mistake; consequently we are taking the time to obtain the fullest possible data on the subject.

"The only reason for the compact is the desire of the upper basin states to conserve for their own use sufficient water for their purposes. The authority granted the commission which drew the compact was to allocate the water between the states. This was not done. The water was allocated between the upper and lower basins. This is the first objection to the compact, as it leaves Arizona in the lower basin occupying relatively the same position which caused the upper-basin states to insist on a compact.

"This objection is made all the more important because of the linking together of the propaganda for the adoption of the Colorado River compact and the building of a dam at Boulder Canyon, as is outlined by the United States Reclamation Service and in the Swing-Johnson bill.

"It may be asked, why should there be objection in Arizona to a dam at Boulder Canyon? The answer is that it is starting development of the canyon at the wrong end, and that a dam at that point would limit agricultural development in Arizona from the Colorado River to 280,000 acres of land. The power development at that point would largely benefit California, and Arizona would derive little, if any, benefit from it.

"It is argued that it will be impracticable to irrigate anything in excess of 280,000 acres of land in Arizona from the Colorado River, yet the supplemental report of E. C. LaRue of the United States Geological Survey, as chairman of the Arizona Engineering Commission, is anything but discouraging to those in Arizona who hope to see 2,000,000 or more acres of land irrigated in the state—of course, not in the immediate future, but it is believed that the plan will be possible long before some of the irrigation projects in the upper basin states for which these states are reserving water under the compact are developed. The compact voiding the law of prior appropriation for beneficial use sets up bargain terms allotting to the upper-basin states 7,500,000 acre-feet of water in perpetuity, and to the lower basin 8,500,000 acre-feet, to be distributed on the basis of prior appropriation for beneficial use unless a supplementary compact is made.

"California refuses to sit in a conference of the three lower-basin states to make such a supplemental compact. As California and New Mexico will inevitably develop earlier than Arizona, it is apparent that Arizona cannot accept a bargain allotment in the upper basin and the doctrine of prior appropriation in the lower basin without forfeiting her interests.

"I believe that power is the only agency at this time that can bear the cost of development.

"One of the main arguments being put forth now is for flood control. The alarm over floods, in my opinion, is exaggerated. During my long residence in Arizona the only menacing floods have been caused by the simultaneous run-off in the Colorado and Gila Rivers. The Gila River floods, while not fully checked, have had their volume reduced through several dams which have been constructed so that the flood menace is proportionately relieved.

"If power development can proceed unhampered in a businesslike way, the benefits of flood control and more water for reclamation will be realized in a surprisingly short time as a byproduct. Eighty per cent of all the power developed in the lower basin will be developed wholly within the State of Arizona, and the other 20 per cent will be developed between the States of Arizona and Nevada. I believe that this development can be best undertaken by the State of Arizona, and that the state can derive greater benefit and furnish power at less cost than can be furnished through any other agency. As the power will be developed in this state, Arizona should determine where it shall be developed in order to be of the maximum benefit to her.

"I recently suggested a conference between California, Nevada and Arizona, in order to arrive at an understanding between the states in the lower basin.

"The Governor of California, as I have already said, refused to appoint delegates to such a conference, and the State Engineer of California, who was the California representative at Santa Fé, stated in a letter to the Governor of Nevada that the upper states were entitled to share in the benefits of any power which might be developed in the lower basin because of any moneys spent by the federal government. I believe it to be the almost unanimous sentiment of the people of the State of Arizona that—irrespective of the opinion of the State Engineer of California and whatever may be the opinion in the upper basin—the upper-basin states will not be entitled to derive any revenue from power developed in the lower basin. While these objections exist I do not believe that Arizona will enter into the compact."

Letters from Our Readers

A Place Set Apart for Suggestions, Comments and Criticisms, to Which All Men of the Electrical Industry Are Cordially Invited to Contribute

Patenting of Engineering Arrangements

To the Editors of the ELECTRICAL WORLD:

An editorial entitled "Two Interests Involved in Patenting Engineering Arrangements," on page 849 of the Oct. 27 issue of the ELECTRICAL WORLD, has come to my attention. This editorial seems to question the wisdom of granting patents on new and useful combinations of apparatus or machines which the editorial terms "engineering arrangements." No objection seems to be raised to the patenting of the individual apparatus or machines. The basis of the objection seems to be the fear that patenting of the so-called "engineering arrangements" will hamper the development of the industry.

The specific statement of the editorial in question is as follows:

"For example, a patent has been issued on at least one isolated-phase arrangement, and others have been granted on various combinations and arrangements of heat-balancing equipment and boiler arrangements. Any company which has duplicated these specific arrangements has technically infringed a patent."

I am familiar with the first instance referred to,

namely, the isolated-phase arrangement, owing to the fact that I prepared and prosecuted the patent application covering the same. It relates to a new switch house and bus construction and was originated by Bertrand B. Jamieson, engineer of inside plant, Commonwealth Edison Company, Chicago. The invention was embodied in the Calumet station of the Commonwealth Edison Company of Chicago and was described in the ELECTRICAL WORLD of April 2, 1921, page 761.

In general, the patent (No. 1,454,744) which Mr. Jamieson received relates to a structure of buses, switches, connected apparatus and the arrangement thereof in a building to secure, primarily, great freedom from danger of interphase short circuit and, secondarily, certain other advantages, such as greater simplicity of construction, greater accessibility of all parts, more working room, ability to dispose the phases above each other and thus reduce the necessary ground space, and other advantages.

The invention has been widely copied, and the question now raised by the editorial under consideration is, Shall subsequent users pay for the employment of this invention or shall they be permitted to use the invention free?

Independently of the patent laws, would it be fair to Mr. Jamieson and to the Commonwealth Edison Company to have them sustain all the expense and labor and danger of loss by unsuccessful venture which they had to undergo in developing this invention, and then let every one who wishes partake of the benefits of the invention without turning a hand? Would it not be more fair and equitable to let the later users pay at least their proportion of the development cost plus something as a reward for the initiative of the original inventor and builder? If all the cost of the initial conception and development of a new idea is to be saddled entirely upon the one who originates such improvements in the art, it places too much of a tax upon initiative. The tendency naturally would be to coast along behind, for it would cost less to let some one else have the expense and grief of developing new ideas.

I realize that the present case is different from the usual patent on a manufactured article in that in the present case it is the user of the invention who secures the chief benefit of the invention and who pays directly the license fee for its use. This license fee therefore is paid as a direct tax by the user. Ordinarily the license fee on a manufactured article is not paid by the user but is paid by the manufacturer, and the user pays the cost of the license fee only as an indirect tax. The principle, however, is in no wise different.

The attitude of the Commonwealth Edison Company toward its employees is very liberal and is a notable example which may well be carefully considered by other industrial and public service organizations. According to the rules in force, each employee is required to submit to a patent board duly constituted of officers of the organization all ideas, improvements and inventions relating to the business of the employer organization. This patent board passes upon the question of whether the employer organization desires rights under the invention or improvement. If the recommendation is favorable, the inventor is directed to file application for a patent on the improvement at the cost of the employer organization and to execute to the employer organization a license permitting it to use in its business the invention or improvement, and payment of a fixed sum in the nature of a bonus is made to the deviser of the invention or improvement.

I am familiar with another instance of a somewhat similar character. This relates to a scheme for arranging the apparatus of a power station so that higher economy may be obtained by the use of auxiliaries electrically driven from the main generating unit but operable on failure of current from the main unit from a house turbo-generator which is normally driven by current from the main unit. This invention was devised by Allen M. Rossman, one of the members of the well-known firm of consulting engineers Sargent & Lundy of Chicago, and was duly patented (No. 1,456,652). It appears that this scheme which Mr. Rossman patented was adopted by the engineers who designed the Wabash River station of the Indiana Electric Corporation without knowledge that it was patented. In accordance with the practice of Sargent & Lundy, a license has been granted to the manufacturer (Westinghouse Electric & Manufacturing Company) and to the user on a nominal royalty fee to reimburse Sargent & Lundy for developing and patenting the invention and to reward the inventor in a very moderate way for his initiative and ability.

DEVELOPMENT COSTS MONEY

For the purpose of more specific discussion suppose that an inventor has invented and developed at his own expense and effort a new switch house, such as the Jamieson switch house, or a new mode of operating a house turbo-generator set like the Rossman invention, and that the Doe Power Company wishes to erect a station embodying those devices, copying exactly the device of the patent. Why should it not be permitted to do so? Why should it not be permitted to construct for its own use only one or more of the devices of the invention? The Doe Power Company does not plan to sell the station nor to manufacture stations for others.

Let us assume that this were permitted. Then each power company could put up as many of the devices as were necessary for its own use, and the result would be that all the stations in the United States could thus be supplied without the inventor being even consulted. Then who would have to stand the cost and loss of time incidental to its development? It would be the inventor. But he gets no income from the invention. He is not able to use the patent as a means to hire out his services as a consulting engineer, because his price would have to be higher in order to reimburse himself for loss of time and costs incidental to the development. It would be more economical to the inventor to let some one else do the worrying and stand the cost of making an invention, because the inventor would see at once that invention is carried on at a loss. An invention would be an asset to every one except the one who produced it. The result would be that invention would be stifled and would be furtively and secretly produced and carefully guarded from public knowledge. This is exactly contrary to the spirit and purpose of the specific clause in the Constitution covering issuance of patents. It is for the purpose of promoting progress of science and useful arts that patents for inventions are granted.

How are engineering arrangements of a different class from other inventions? The statutes passed by Congress state that patents may be granted for inventions in any of the four classes of "art, machine, manufacture or composition of matter, or any improvement thereon." Some of these engineering arrangements are undoubtedly in the class of "machine" and others no doubt in the class of "manufacture." The Patent Office has held that these inventions come within the statutory

classes, as is obvious from the above particular patents to which I have referred. Furthermore, I know of no case where a court has held that an improvement or invention, such as the Jamieson invention or the Rossman invention, was not protectable under the existing patent law.

As pointed out before, it is true that in this class of inventions the user—i.e., the plant operator—is the chief beneficiary of the advantages of the invention. But the contractor or engineer who erects the device is also the gainer from the construction of the device. And the manufacturer of the apparatus employed also gains by the manufacture and sale of such apparatus. And the public, not least to be considered, benefits most of all.

There is no compulsion upon any one who erects a power plant to use the patented invention. The devices which existed prior to the patented invention are always open to the public and may be used freely. If one deliberately copies the advantageous arrangement devised and perfected by another, he should expect to make fair payment therefor. Where the infringement was inadvertent, as in the case of a later but independent inventor, the equities are not so unequal. But it is an old principle of the law that where equities are equal the law must prevail. The rights of the first inventor should not be impaired by the subsequent act of another.

Your editorial also raises the point that the patent situation will necessitate a patent searcher for each utility company.

Why cannot the public utility men do the same as automobile companies, which buy great numbers of parts, materials and equipment from independent manufacturers? They could not in each instance investigate the patent situation as could one who supplies the particular part, because each man is familiar with patents on his own line of goods. The automobile manufacturer when he places his order specifies:

"By accepting this order the seller hereby agrees to save the buyer harmless against all suits for patent infringement on the parts or material supplied on this order."

Now the utilities are in somewhat the same situation, only the point under consideration is not the question of whether the individual apparatus infringes, but whether the apparatus when assembled and combined constitutes an infringement on some patent covering a so-called engineering arrangement.

Whereas the automobile companies generally buy from manufacturers and dealers of less financial resource and stability than they are, the utilities generally deal with highly responsible manufacturing concerns. The manufacturer who supplies a piece of apparatus knowing that it is to be employed in a certain combination of apparatus is as guilty of patent infringement as is the user, if that combination is patented (on the legal doctrine of contributory infringement). In other words, the manufacturer who sees the plans and specifications of the proposed installation is charged with the duty of investigating the patent situation and is liable for infringement if he then supplies a part of a patented combination. This is well known by most manufacturers.

Since the manufacturer has the facilities for investigating these matters and must do so for his own protection, I can see no good reason why the manufacturers should not give the utilities a guarantee on this point. Let the utility insert a clause in its contracts as follows:

> This material is bought for installation and use in erecting a generating station [or substation, or transmission system] known as the....., the construction of which is shown and described in the plans and specifications prepared by....., engineers, and dated ....., a copy of which is on file at the office of the purchaser at....., open to your inspection. The seller in supplying material on this order hereby agrees to save the purchaser harmless from all claims for patent infringement, primary or contributory, based upon the use of the material so supplied in the construction of such ....., according to the plans and specifications referred to above.

The consulting engineer and contractor may also be liable for patent infringement on the basis of contributory infringement and suitable stipulations may be made in contracts with them, but this is far less effectual as they have not the means to make proper investigation and generally have no invested capital.

By the foregoing suggestions I do not mean to advise the utility operator to dodge the issue. He should make his own investigation and use reasonable caution. An investigation on the main features can readily be made at no great expense, and such investigation is a necessary insurance of the capital invested. But he should put the real burden of the investigation upon the manufacturer, because the manufacturer can distribute the cost of the investigation as overhead on a large number of installations by settling at a single investigation the question for all installations of like character.

The utility operator is not familiar with the individual arts and the patent problems involving the same, and any investigation he would make would be for his own station only. It would, therefore, not be so likely to be thoroughly and intelligently done, and it would involve a relatively large outlay as overhead for a single installation.

I, therefore, suggest as the proper way to handle the situation mentioned in the editorial the following:

1. In making contracts for purchase or installation of apparatus and equipment and the like introduce a clause in the contract for purchase or installation of the character above explained, thereby putting the responsibility for the investigation upon the seller or erector, where it properly belongs.

2. Make an independent investigation on any features known to be new or unusual, where such feature is an important part of the station or installation. Employ competent counsel; otherwise the effort may be wasted.

3. Assist the development of the industry by patenting and thereby revealing to others improvements in apparatus or methods of operation which the utility operator may devise.

4. Adopt a plan of procedure in connection therewith which will serve as a reward and act as a stimulant to employees. (The plan adopted by the Commonwealth Edison Company of Chicago is suggested as a model.)

JOHN A. DIENNER.

Brown, Boettcher & Dienner, Attorneys and Counselors, Chicago, Ill.

[The editorial in question did not depreciate the value of the two patents nor take a stand against the practice in those two cases, but raised the question for discussion how patents on engineering arrangements could be granted so that the utilities and the public would not be handicapped but on the other hand most benefited. The situation as to patents of this kind is not now serious enough to bother any one. But enough companies have raised objection to patents of this sort to indicate that the subject warrants discussion. Mr. Dienner's letter is an able presentation of one aspect of the subject.—EDITORS.]

Central Station and Industrial Practice

Installation, Operation, Maintenance, Test and Repair of Generation and Distribution Equipment, and Methods of Economically Utilizing Electric Service in Large Industrial Plants

One Tower a Day with Eight Men

Indiana Company Assembles 80-Ft., 8,000 Lb. Towers in Sections on Ground and Brings Them to Erect Position with Steel Gin Pole and Tractor

By Ole Davidson

Assistant Superintendent Construction Department, Indiana Electric Corporation, Indianapolis, Ind.

A COMPROMISE between building towers up from the ground, one member at a time, and assembling the entire tower in sections on the ground and then erecting has been adopted by the Indiana Electric Corporation in building its 132,000-volt line from Terre Haute to Indianapolis, a distance of 74 miles. The towers, which are 80 ft. in height and weigh 9,800 lb., including the foundations, are spaced about 800 ft. apart with a ground clearance of 22 ft. The towers carry six No. 4/0 copper conductors and one $\frac{7}{16}$-in. galvanized ground wire. The insulation consists of one string of nine disks in suspension and eleven disks on each side for dead ends. Right-of-way is being obtained for two tower lines 110 ft. apart.

The line traverses a well-settled farming country with about four property owners to the mile. The problem in surveying the line was to secure a right-of-way that would avoid farm buildings. To do this it was deemed necessary to obtain an option on the right-of-way before detailed surveys were made. Maps of the country were procured from different sources, and from these a general map was made on which the theoretically desirable line was traced. Automobiles with speedometers were used to locate the improvements along this line. To avoid improved sections it was necessary to make slight deviations from the theoretical line, but none the less the right-of-way options were based on this paper location.

After options on a reasonable amount of the right-of-way had been obtained the regular surveys were started, the transit line being the center line of the north tower line, and levels were taken 15 ft. on each side of the transit line. Maps and profiles were plotted to a scale of 200 ft. to the inch horizontally and 20 ft. to the inch vertically, each sheet covering about a mile of line. With an appropriate sag curve, tower locations were made on these profiles. The tower locations in the field varied slightly from this paper location, depending on the local conditions. Setting of the steel footings involved no new features except the use of the "farm level" instead of the customary level board and carpenter's level.

Details of Erection

Tower erection was divided between three crews. One was the assembly crew, consisting of a pusher and three ground men, which assembled the tower parts in six flat sections on the ground, averaging two and a quarter towers per nine-hour day. The second crew, which was an erection crew, consisted of a foreman, a tractor driver, four "high men" and three or four ground men. Their equipment included one 30-ft. built-up steel gin pole, one tractor, and a wagon with a special body to carry the gin pole, rigging and small tools. This crew erected on an average two towers per nine-hour day. The third or finishing crew consisted of a pusher, two "high men" and a ground man. These men followed the erection crew and filled in the members which of necessity had been omitted in erection. This crew completed (placing and tightening all bolts) one and a quarter towers in a nine-hour day.

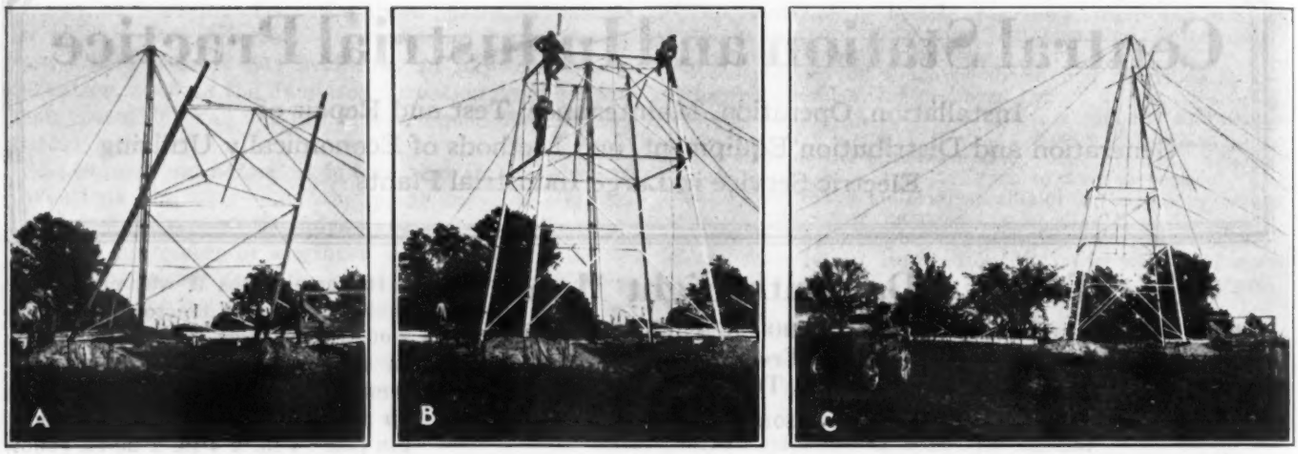
In order to compare the speed of tower erection on various jobs it is necessary to know the weight, number of pieces and number of bolts in a standard tower. The portion above the ground weighed 4 tons and consisted of 166 pieces and 743 bolts.

In some places it was not practicable to use the tractor outfit previously mentioned in erecting towers. In such cases the towers were assembled in the air by building them up one piece at a time. A wooden gin pole (4-in. x 4-in. x 20-ft. yellow pine) was used to raise the heavier pieces. The gin pole was raised from story to story as needed. A foreman, four "high men," two ground men and a team erected five standard towers in six nine-hour days.

Before erecting the towers with the tractor outfit, eight pairs of guy stubs were driven around each tower, 90 ft. from the center at the 90-deg. and 45-deg. points. These stubs consisted of 6-ft. by 2-in. black pipe sharpened on one end. Five of the guys consisted of $\frac{3}{4}$-in. manila rope with 15 ft. of $\frac{3}{8}$-in. cable next to the gin pole. A sixth one, consisting of $\frac{3}{4}$-in. rope with no cable, was used as a safety guy and later was employed to lower the gin pole from the top of the tower. The lower story of each tower was assembled on the ground in two sections, one on the north side and one on the south side of the tower foundations. For the second and third stories the east and west faces were assembled on the east and west sides of the tower foundations, respectively. As much of the side lacing as could be expeditiously handled was fastened to these assembled sections.

Method of Raising Towers

Upon arriving at the tower site the wagon trailer carrying the gin pole was pulled through the center of the tower and stopped at such a place that the base of the gin pole could be landed at the center of the tower without removing it from the wagon. The base of the gin pole rested on a built-up wooden block measuring 2 ft. x 2 ft. x 4 ft. and was bridled to the foundations to keep it from slipping. The guys were then attached and strung out in their proper location, and the regular hoisting line was attached to the tractor which raised the gin pole

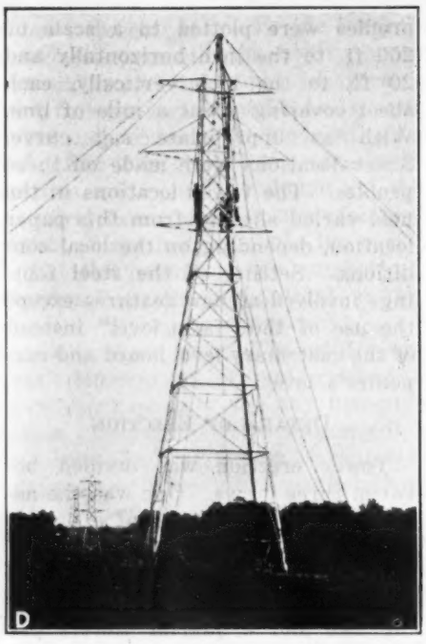


on a direct pull. The main hoisting falls consisted of ⅞-in. manila rope and two single 8-in. wood mortise blocks.

After the gin pole and guys had been placed in position, the north and south faces of the tower were pulled up and fastened to the steel foundation and a part of the lacing on the east and west facing was bolted up. The gin was then hoisted to the second story, the foot of the gin riding on a hook over a strut on the tower immediately under the leg joint. After the gin was properly raked and the guys were in position the east face of the second story was raised and the leg joints were full bolted. It was then necessary to slide the foot of the gin along the strut to the opposite side of the tower and raise the west face of the second story as before. The lacing on the north and south faces which was attached to the sections was then bolted up. The gin was then raised a second time and, as before, rested on a hook over a strut to the top of the second story immediately under the leg joint. The west and east faces were pulled up, and the lacing attached to the section on the north and south faces was bolted. The last lift carried the bonnet of the tower, which was christened by the gang the "goat head" as it sometimes "got their goat" to get it in place.

During the process of raising the north, south, east and west guys remained tied to the same guy stubs. The other two guys were shifted from the northeast to the northwest and from the southeast to the southwest stubs as load conditions demanded. After the last section was in place and all side lacing bolted up the five guys were thrown off and the north (safety rope) guy was used to lower the gin. In the meantime the tractor had pulled the trailer under the center of the tower and the gin pole was laid on the top of the trailer body, which was especially designed to carry it. Meanwhile the guy stubs were pulled and the guys coiled and loaded so that the outfit would be ready to move to the next tower.

When the tractor crew left a tower 90 per cent (by weight) of the steel was in place in the air and 65 per cent of the bolts in place and tightened. The remainder of the material left on the ground for the follow-up construction crew to assemble.



132,000-VOLT TOWERS USED BY THE INDIANA ELECTRIC CORPORATION BETWEEN TERRE HAUTE AND INDIANAPOLIS

A—Gin pole erecting first section of tower by direct pull from tractor. B—First section of tower completed. C—Gin pole, in place on first section, erecting second section. D—Erection of tower completed except for insertion of minor members.

Kelsey, Brewer & Company of Grand Rapids, Mich., are the constructing engineers; L. B. Andrus vice-president and chief engineer, F. G. Dana, superintendent.

Fault-Locating Equipment for Lighting Circuits

THE Haverhill (Mass.) Electric Company recently purchased an amplifier from the Lundin Electric & Machine Company, Boston, for use with the latter's fault-locating equipment in overhead maintenance. To avoid using the amplifier with an exploring rod, which is better adapted to transport on an open automobile than in a closed car or on one with the top up, it was found that by connecting the exploring-rod binding post to the metal frame on top of the car and the ground terminal with the frame of the car the amplifier would work. Afterward 25 ft. of fixture wire was placed between the inner and outer tops of a Ford coupé, one end being brought to a binding post inside the car, using this as a collecting agency instead of the frame on top of the car.

As a test the line crew opened an arc circuit by disconnecting the lead to a lamp, taping the end and laying it on top of the lamp and outside the range of vision from the street. The lamp was about 1.5 miles from the station, and in twelve minutes after leaving the latter the "open" was located. This amplifier is similar in construction to equipment for one stage of radio-frequency amplification as ordinarily used in radio receiving outfits.

It is essential when using this outfit that the station operator analyze the open circuit and connect the fault locator on the short wire to obtain the quickest results.

Keeping Operating Charts Readily Available

By Frederick L. Ray
Superintendent Power Plants, Traction, Light & Power Company, Anderson, Ind.

THE value of operating plant charts and records depends upon the condition in which they are kept at the superintendent's office. Unless they are filed in a manner easily accessible they become worse than useless. No detailed checking of plant economy can be accomplished unless the records are complete and in their proper place. The mistake of installing high-grade and expensive instruments without keeping their graphs for study needs no proof.

To facilitate this object the Traction, Light & Power Company constructed a rack to accommodate twelve various-sized charts. Wooden pegs were inserted for holders so as to prevent tearing the charts when they are being mounted. To keep them from flying off the pegs, small round wooden disks were turned out on the company's lathes. The rack is placed on the wall near the left-hand side of the superintendent's desk so that he can stretch out his hand and reach any chart desired.

Compact Storage of Central Station Supplies

AT THE recently completed Melrose service station of the Narragansett Electric Lighting Company, Providence, R. I., provision has been made for storing rigid conduit and reels of cable and rope with minimum occupation of space. Fig. 1 shows a skeleton timber rack layout for holding conduit in vertical or inclined stands. The rack is assembled of 12 in. x 12 in. uprights tied together by a longitudinal stringer of the same cross-section, bays for the reception of different sizes of pipe being formed by 4 in. x 6 in. crosspieces. Stacking conduit in this way enables desired sizes to be withdrawn without interference with other sizes and gives a continuous visual check of the amount of stock on hand.

Reel storage (Fig. 2) is effected by setting the bearing spindles carrying the spools into diagonal slots in fabricated steel T-members ½ in. thick, these members being installed as uprights and tied into horizontal cross-members at top and bottom by bolts. A flexible arrangement meeting the space requirements of different-sized reels is assured by the provision of numerous bolt holes in the horizontal members and by frequently recurring slots in the uprights. Jenks & Ballou, Providence, were engineers and architects of the new service station.

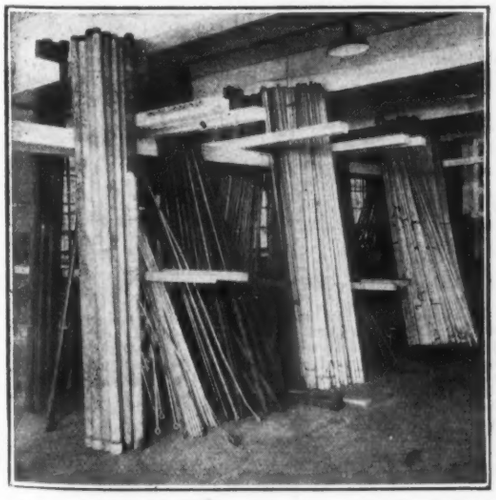
Michigan Rules on Wattmeter Installations*

Sealed Switch Boxes, Safety Cabinets and Suitable Locations Are Made Obligatory by Rule 1692 of Public Utilities Commission

UNDER Rule 1692 of the Michigan Public Utilities Commission, the entrance switch boxes shall be so arranged, sealed or locked that unauthorized persons cannot tamper with either the switch or the main line fuse; provided, however, that in an emergency a consumer may remove this seal from the main fuse compartment if the utility is promptly notified that the seal has been removed. All service wiring passing through or along partitions to entrance switches shall be installed in continuous lengths of approved rigid metal conduit up to the entrance switch and be equipped with proper fittings. No exposed wiring shall be installed between the entrance switches and meters. The entrance switches and cut-outs, except where installed on approved switchboards or panels, shall be inclosed in metal boxes of approved safety inclosed type, so designed that the switch may be operated by a suitable handle on the outside of the switchbox. The covers of such a switchbox shall be so designed that they can be either sealed or locked in a closed position, and the switch handle shall be so designed that it can be locked in the open position, and they must indicate whether they are open or closed.

No utility shall furnish electric supply service to any applicant until the installation of utilization equipment to be served has been approved by a recognized inspection agency or the controlling civil inspection authorities. In case this does not exist, the utility shall make an examination and inspection of the installation, and if there are any evident violations of the rules of the commission governing the installation, the utility shall not furnish service until these violations are corrected. In case of disagreement re-

*An abstract of the meter committee's report, J. C. Langdell, chairman, before the Great Lakes Division, N. E. L. A., Sept. 27, 1923.



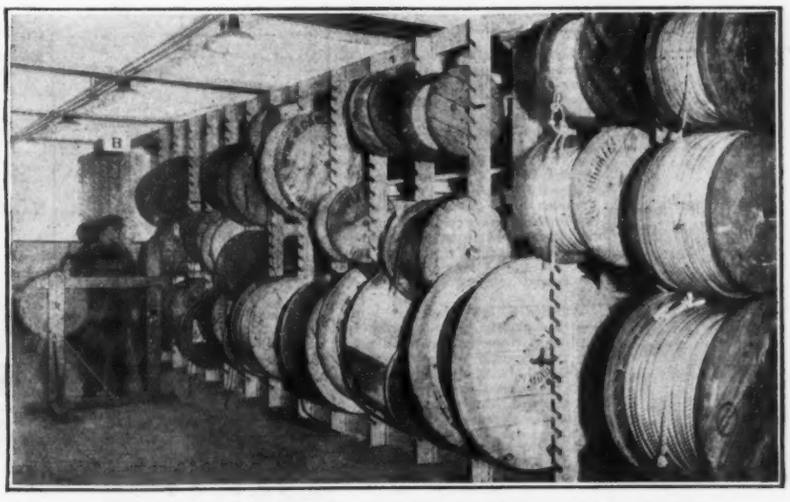


FIG. 1 (LEFT)—SHELETON ON TIMBER FRAME SUPPORTS RIGID CONDUIT. FIG. 2 (RIGHT)—STEEL RACK KEEPS REELS OFF THE FLOOR

garding installations the matter shall be referred to the commission for a ruling.

Although the 1922 report of this meter committee showed a varied practice among companies regarding the use of meter safety cabinets, at this time (September, 1923) manufacturers of meter and service equipment have small-sized cabinets well standardized from a standpoint of dimensions. Cabinets with service switch and fuse connection blocks are available in the 30-amp. size. These cabinets take the place of the service switch and meter fitting formerly used. In all cases provision is made for carrying the neutral wire through the cabinet without a fuse, and in some cases also with a disconnecting link instead of the switch blade as approved by the National Electrical Code. Provision is made at the neutral cabinet for connecting the ground wire, which can be brought into the cabinet through a knockout in the bottom.

The connection blocks have a provision for testing the meters without interrupting the customer's load or disturbing any of the permanent wiring connections. This provision consists of a switch blade on the load side of the meter which can be opened only from within the cabinet. All switches are operated from the outside of the cabinet and shut off the current from the meter. For the mutual protection of both consumer and company, all service and meter cabinets should be kept sealed in order to accomplish the full safety designs of the equipment. Consequently, when they are of a fused type, the circuit fuses are to be provided on the load side of the meter, which will be accessible to the customer. Fuses in the meter cabinet should be of a size determined by the capacity of the connection block and should be heavier than the customer's fuses.

During the year the meter committee investigated to find what attention had been given power-factor correction. Out of eleven questionnaires submitted, four companies said that they were measuring power factor for billing purposes. One company reported that in doing this it makes use of two watt-hour meters by employing auto-transformers to determine the reactive kilovolt-ampere hours. Measurements are made of the customer's power factor from time to time, and the customer's demand is increased in the ratio of 90 to the measured power factor when the measured power factor is below 90 per cent. No data as to the frequency of measurement of testing were included.

Another company reported the same method of determining the power factor and the same method of application, with the exception that it used 70 per cent as the standard power factor instead of 90 per cent. Power-factor measurements are made on a given installation every six months.

Another utility follows the same method, except that measurements are made monthly. The power factor is determined from the meter readings in the usual manner, but corresponding to every power factor is a multiplying constant by which the kilowatt-hour consumption is multiplied to give the energy consumed. The standard power factor in this case is 85 per cent. Another company reports two methods of measurement in use. For secondary customers the standard method with two watt-hour meters and auto-transformers is used, while for primary customers the middle tap on the secondary of the potential transformers is used. The method of application to the ratio is the same in both cases. A standard power factor of 80 per cent is adopted.

Electrical Insulating Materials

A COMPARATIVE summary of the properties of hard rubber, vulcanized fiber and laminated and molded phenolic insulated materials, as taken from the Technologic Paper No. 216 of the Bureau of Standards, was published on page 544 of the Sept. 15, 1923, issue of the ELECTRICAL WORLD. This was quoted from a copy of the above paper as first issued, which did not contain some corrections embodied in the corrected reprint subsequently issued. These corrections affect the last three items of the table, which are reproduced herewith. The data regarding the effect of sunlight on these materials, withheld from the first table on account of space limitations, are also included.

COMPARISON OF PROPERTIES OF VARIOUS INSULATING MATERIALS

Properties	Hard Rubber	Vulcanized Fiber	Phenolic Insulating Materials	
			Laminated	Molded
Sunlight	Surface discolors and deteriorates after a few months; the sulphur of the hard rubber is oxidized, forming the equivalent of sulphuric acid; this may take up ammonia from the air or may attack the filling materials forming the various sulphates upon the surface; the surface resistivity is greatly reduced.	No effect.	No visible effect.	After two and one-half years some materials show a slight change, such as discoloration or very fine cracks; other materials show no such change.
Metallic inserts	Cases have been observed in which there is corrosion of copper and brass inserts at the exposed junction of metal and hard rubber; no such corrosion of bronze or tinned inserts has been reported.	No effect.	No effect.	No effect.
Machining qualities	Admits of high polish; machines less accurately than would be supposed, due to great resiliency; the better the grade the more readily it is machined; quality may be judged roughly by color and texture, toughness, color and grain of a shaving; has tendency to warp; can be molded to size within plus or minus 0.002 in.	Admits of a fine finish; may be sawed, punched, drilled, stamped, embossed, turned, planed, bent, tapped; tough, resists shock; cannot be molded.	Admits of a good polish; can be sawed, punched, drilled, stamped, turned, planed, knurled, embossed, milled, tapped either with or against the grain, though not as easily as hard rubber and vulcanized fiber; tough, resists shock; cannot be molded.	Admits of a fine lasting polish; can be machined, cut, filed, sawed with difficulty; can be molded to size within plus or minus 0.001 in.; quite brittle.
Cost	About $0.50 to $1.10 per pound in sheet form.	50-80 cents per pound up to 1 in. in thickness; about $5 per pound for 2 in. in thickness.	About $1 per pound.	Cost varies with complexity of steel molds.

Central Station Business

Advertising, Selling and Service Methods
Commercial Organization and Management, Customer and Trade Relations, Public and Financial Policies, and Reports of Company Plans and Experiences

Advance Schedule for Sales and Advertising Gets Results

Central-Station Company Serving Several Small Communities Averages $18.60 Appliance and Lamp Sales per Customer per Year

By H. C. Thuerk
Commercial Manager Keystone Power Corporation, Ridgway, Pa.

FOR the past year a complete advertising and merchandising schedule has been used effectively to increase the sales in the appliance and contracting departments of the Keystone Power Corporation. The scheduling of commercial programs has been comparatively simple in form, but the results attained have demonstrated the wisdom of careful planning ahead.

The company maintains retail stores in the towns of Ridgway, Johnsonburg, Kane and Mount Jewett, in the north central part of Pennsylvania. These towns have populations of 6,200, 6,500, 7,500 and 1,800 respectively and are relatively close to each other. They are connected by good state highways so there is considerable interurban traffic. In addition, the newspaper in each community has a rather large circulation in the other towns.

With these conditions in mind it was decided to operate the four stores as a unit. In carrying out this idea the show windows in each of the stores display the same merchandise and appliances at the same time, newspaper advertising in each town is related definitely to the show-window displays, and in like manner all other forms of advertising and sales efforts are co-ordinated.

The merchandising schedules used are planned ahead to cover a period of four months. This has been found to be the most satisfactory plan, for schedules covering longer periods must be revised often to accommodate special campaigns. Selling or advertising campaigns conducted by manufacturers can usually be anticipated four months in advance if effort is made to secure the necessary information.

The schedule reproduced here covers the period from April 27 to Aug. 29. It will be noted that this schedule is outlined by weeks, so that the salesmen in charge of the stores know exactly what appliance to feature in the windows and what to advertise in the newspapers on the different days of the week. It gives them instructions as to advertising material which should be inclosed with the monthly electric bills and daily appliance invoices, and also indicates under "Remarks" special window displays, special advertising literature, etc. It may be mentioned here that this company does electrical contracting work and that its newspaper advertising on one day of each week concerns housewiring.

It has been found that by using this schedule considerable time has been saved by the salesmen in trimming windows, and windows are trimmed regularly. Previous to the adoption of this plan the windows were trimmed spasmodically, and much time and energy were wasted deciding what should be placed on display. This schedule, however, does not discourage individual initiative, for the arrangement of the windows is left entirely to the local man.

The merchandising schedule is tied in as closely as possible with the

TABLE I—COMBINED GROSS APPLIANCE, MERCHANDISING AND HOUSEWIRING SALES BY MONTHS

	1922	1923	Per Cent Increase
January....	$4,829.32	$6,251.57	29.4
February...	4,207.13	4,338.80	3.1
March.....	3,542.80	7,362.07	107.9
April.....	6,493.61	9,512.25	46.5
May.....	4,866.78	8,465.38	73.9
June.....	3,964.90	8,381.67	111.3
July.....	3,741.33	7,773.20	108.0
August....	4,960.89	6,796.80	37.0
September..	4,479.81	8,346.84	86.3
October....	9,616.73	10,951.22	13.9
Total....	$50,703.30	$78,179.80	54.3

SALES AND ADVERTISING SCHEDULE, MAY 1, 1923, TO SEPT. 1, 1923*

Week	Appliance to Push	Show Windows: Right	Show Windows: Left	Newspaper Advertising: Fri. and Sat.	Newspaper Advertising: Mon., Tues. and Wed.	Newspaper Advertising: Thurs.	Theater Slides	Inclosure with Lighting Bills	Inclosure with Appliance Invoices	Remarks
April 27–May 3	Cleaners	Lamps	Cleaners	Lamps	Cleaners	Wiring	Cleaners	Cleaners	Fans	Cleaner broadsides
May 4–10		Cleaners	Toasters	Toasters	Cleaners	Wiring	Toasters			
May 11–17		Fixtures	Cleaners	Fixtures	Cleaners	Wiring	Cleaners			
May 18–24		Cleaners	Wiring Supplies	Supplies	Cleaners	Wiring	Cleaners			Decoration Day window
May 25–31		Irons	Washers	Irons	Washers	Wiring	Washers			
June 1–7	Fans	Curlers	Table Appliances	Curlers	Appliances	Wiring	Curlers	Fans	Irons	Wedding gifts
June 8–14		Fans	Ranges	Fans	Ranges	Wiring	Fans			Flag Day, June 12
June 15–21		Cleaners	Fans	Fans	Cleaners	Wiring	Cleaners			Range demonstration
June 22–28		Fans	Lamps	Stoves	Fans	Wiring	Fans			
June 29–July 5	Irons	Washers	Irons	Irons	Washers	Wiring	Washers	Irons	Washers	Fourth of July window, Iron campaign (Special prizes for employees)
July 6–12		Irons	Fans	Fans	Irons	Wiring	Irons			
July 13–19		Fixtures	Irons	Fixtures	Irons	Wiring	Irons			
July 20–26		Irons	Cleaners	Irons	Cleaners	Wiring	Cleaners			
July 27–Aug. 2		Toasters	Irons	Toasters	Irons	Wiring	Irons			
Aug. 2–8	Washers	Percolators	Washers	Percolators	Washers	Wiring	Washers	Washers	Cleaners	
Aug. 9–15		Washers	Table Appliances	Appliances	Washers	Wiring	Appliances			
Aug. 16–22		Cleaners	Lamps	Lamps	Cleaners	Wiring	Cleaners			
Aug. 23–29		Stoves	Washers	Stoves	Washers	Wiring	Washers			

*In using this schedule windows should be trimmed on Fridays. To save time newspaper advertisements for a whole week should be prepared at one time.

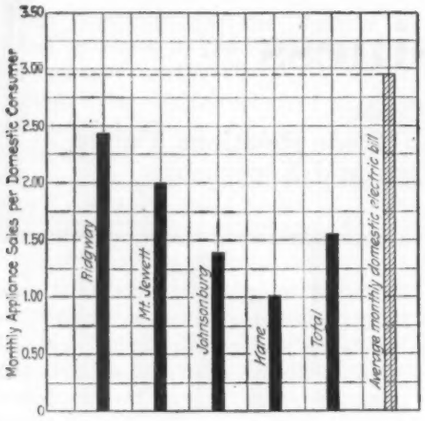


FIG. 1—RELATION BETWEEN APPLIANCE SALES AND DOMESTIC LIGHTING REVENUE

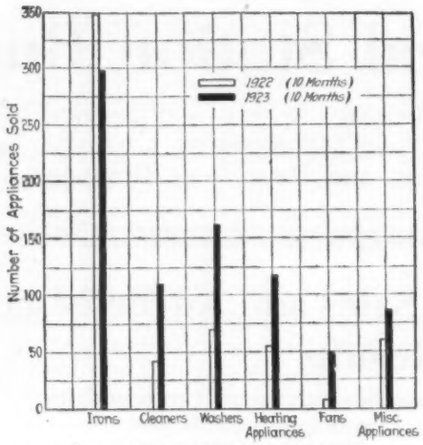


FIG. 2—COMPARISON OF APPLIANCE SALES, 1923 AND 1922

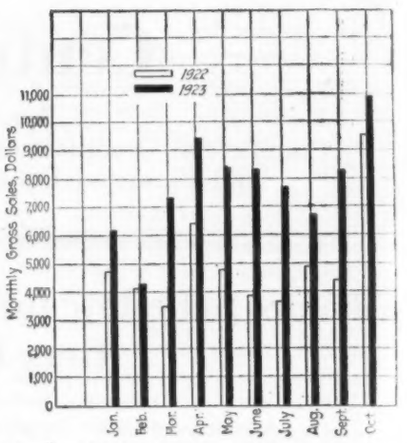


FIG. 3—MERCHANDISE SALES FIRST TEN MONTHS, 1922 AND 1923

national schedule of the manufacturers whose merchandise is sold. The window-display service of one of the largest manufacturers of household appliances is being used and is considered when the schedules are prepared.

Special campaigns are in progress most of the time and are indicated on the schedule. A separate letter of instructions is sent to every manager and salesman for each campaign, and prizes are always given as inducements to the salesmen. It might be well to state at this point that competition is keen in the territory served by this company. In Kane there are two other retail electrical stores, and there is one each in Ridgway and Johnsonburg.

The accompanying tables show how the gross sales of this year compare with the corresponding period in 1922.

Table I shows the gross merchandise, appliance and house-wiring sales by months for the first ten months of the past two years. It can be seen that each month's sales show an increase over the corresponding month of the previous year. The merchandising schedule was first used during September, 1922, so that real results from its adoption could not be expected at once.

The gross sales for the ten months of 1923 showed an increase of 54.3 per cent over the corresponding period of 1922. If we consider only the first seven months of 1923 and compare the gross sales during these months with the corresponding seven months of 1922 (during which no schedule was used), we find the gross sales have increased 67.8 per cent.

Table II shows the relation between appliance sales and domestic consumers in the towns where retail stores are maintained. Gross sales of tungsten lamps have been included under "Appliance Sales" in this table. The lamp sales constitute 5 per cent of the total appliance sales.

The appliance sales per month per residential customer vary from $1.01 to $2.42, with an average for the entire property of $1.55. If we assume that average sales for the seven months represent a fair average for all months, then on a yearly basis these figures vary from $12.12 to $29.02, with an average of $18.60. No separation of appliance sales from all merchandise and jobbing sales was made until April of this year, so that figures are available for comparison purposes from this date only.

The lower showing of the Kane store is due to the fact that from May to September inclusive no outside salesman was employed. The appliance sales per consumer at Kane for April were $2.02 and for October $1.52.

The figures given in this table show that in two of the towns, Ridgway and Mount Jewett, the monthly appliance sales per domestic consumer are very nearly as large as the average domestic electric bill in these towns.

Table III shows how the total number of appliances sold in 1923 has been increased over a corresponding period in 1922. The most important comparison here from the standpoint of the appliance business is the large increase in the number of washers and vacuum cleaners sold. This increase has been due to systematic and carefully planned campaigns carried out with the cooperation of the jobber and manufacturer.

The comparisons at the bottom of Table III are of special interest to central stations from the electric revenue standpoint. As a result of the merchandising plans outlined above, the added load in kilowatts due to appliance sales has been increased 10.4 per cent and the estimated annual revenue from appliances has been increased 17 per cent. These figures were obtained by using the average values of wattage and annual kilowatt-hour consumptions of the various appliances, as recommended by the Society for Electrical Development and manufacturers of electrical household appliances.

TABLE II—GROSS APPLIANCE SALES FOR APRIL TO OCTOBER, 1923, INCLUSIVE

	Average Monthly Appliance Sales for Seven Months	Number of Domestic Consumers as of July 1, 1923	Appliance Sales per Domestic Consumer Per Month	Per Year	Average Monthly Domestic Electric Bill for Year Ended Sept. 30, 1923
Ridgway	$1,993.93	823	$2.42	$29.02	$2.96
Johnsonburg	756.51	548	1.38	16.56	2.26
Kane	1,262.12	1,253	1.01	12.12	3.28
Mount Jewett	275.86	140	1.97	23.64	2.40
Total	$4,288.42	2,764	$1.55	$18.60	$2.96

TABLE III—NUMBER OF APPLIANCES SOLD

	First Ten Months, 1922	First Ten Months, 1923	Percentage Increase
Irons	348	297	14.6*
Cleaners	42	109	159.5
Washers	69	162	135.0
Heating appliances	55	117	112.7
Fans	8	50	525.0
Miscellaneous appliances	60	88	46.7
Total	582	823	41.5
Added load in kilowatts	233.2	257.3	10.4
Estimated annual revenue	$2,981.80	$3,489.40	17.0

* Decrease.

Rate Reduction Receives Praise from Press

PUBLIC relations and good will were furthered recently by the voluntary reduction of rates on the part of the Northern Connecticut Light & Power Company. A two-part rate based on an initial charge of 12.5 cents per kilowatt-hour for the first 1.5 kw.-hr. per 100 sq.ft. of floor area, with an energy charge of 6 cents per kilowatt-hour for all additional service and a minimum charge of $1 per month, will go into effect Jan. 1 on the system of the company. At the same time the commercial lighting rates will be reduced from 13 cents maximum, net, to 12.5 cents maximum net, on a block plan, with two steps in place of three previous steps, all energy used above the first block to be billed at 9 cents net.

In a full-page advertisement Walter P. Schwabe, vice-president and general manager, announced the reduction as voluntary and due to the increased number of customers and more liberal use of electricity, despite continued high costs of operation. Typical savings by average, large and small customers are cited for the old and new rates. Local editorial comment, which refers to the action of the company as "an oasis in a desert of ascending prices," says:

> The announcement of the reduction in its electric lighting rate by the Northern Connecticut Light & Power Company will doubtless be received with no small amount of satisfaction by the customers. It comes like an oasis in a desert of ascending prices. In addition to the material benefit—and in dollars and cents this is no insignificant sum—there is the feeling of gratification that it will give the consumer to know that the act is voluntary on the part of the management of the company. So far as the public was concerned, there was neither demand or agitation for this reduction. Had the lighting company elected to do so it might have gone on indefinitely on the present basis of charges. It apparently prefers the policy of giving the consumers the benefit of anything that accrues over a reasonable return on the investment. That this policy will be well received here is certain. It is an impressive indication of community interest that should have a salutary effect on those who insist that nothing good comes from a public service corporation.
>
> In some respects, of course, it should be remembered that the local concern differs from the average corporation of this character. Considerable of the stock is owned by the local consumers, which gives it a common community status above the average. The general manager, Mr. Schwabe, has gone to no small expense in placing the full details of this reduction before the people in this issue. His statement should be carefully studied by the people, for that is the primary purpose in making it public in this manner. No detail appears to be lacking in this published statement to make the new rate clear, and the reward for the effort will come from the intelligent grasp it is hoped the public will take of it.

Commissioners' Views on Utility Problems

ALTHOUGH there is no industry that requires a better public appreciation of its problems than the public utility business, unfortunately no industry is less understood, Sherman T. Handy, Michigan Public Utilities Commission, declared recently. Hence the utilities' problems and aims should be taught in the public schools so that the younger generation can educate their parents. Regulation will last in its present form, Mr. Handy contended, only so long as commissions have the confidence of the public, and utilities must help maintain this confidence. He expressed an abiding faith in human nature and expressed a belief that the public will allow utilities a fair return if they understand the business. More harm can be done to public relations by improperly conducted office routine than in any other way, Mr. Handy thought.

Consolidation is the order of the day, but there have been some regrettable accompaniments, in the opinion of Lewis E. Gettle, chairman Railroad Commission of Wisconsin. These have been due to the acquisition of properties at excessive prices (1) because too much weight has been given to going value, (2) through the payment of nuisance values, and (3) because of bidding among competing companies. The issuance of securities on such inflated valuations cannot be allowed by the commissions, Mr. Gettle declared. While he expressed recognition of the fact that these conditions do not exist everywhere, he said there were a few cases in Wisconsin which will magnify the seriousness of the problem from the industries' viewpoint if they are not completely eradicated.

He also referred to a case where unnecessary construction work was done by one company having a separate engineering organization, just to get the profit on the work. Expansion should be based on known growth and not on speculation, since nothing stirs up the public more than corporate profligacy and extravagance.

What Other Companies Are Doing

Bangor, Maine.—Plans are being matured for an electric show in the early spring under the auspices of the Bangor Railway & Electric Company and local contractor-dealers. A radio broadcasting license has been secured by the Bangor company and a transmitting station installed at its headquarters offices to be used in creating interest in the progress of show plans. Edward M. Graham is president and general manager. A representative of the ELECTRICAL WORLD gave an informal talk last week upon electric show policies at a joint meeting of local electrical men Dec. 11.

Boston, Mass.—The first month's sale of kitchen-lighting units in five small suburban towns served by the Edison Electric Illuminating Company totaled 1,000 purchases of 100-watt and 150-watt outfits, the former size predominating. Eight salesmen are at work, and up to Nov. 30 only two withdrawals had been reported from the total of sales.

Chicago.—The Central Station Institute of the Commonwealth Edison Company, Chicago, has 813 students enrolled in nineteen different classes. This institute was founded to interpret the central-station industry to its employees and to serve as a training school for college graduates. Sixty-four college graduates are at present taking the regular central-station practice course, while 243 others are engaged in the study of engineering and operating theory. New employees to the number of seventy-five are getting their first contact with the company, and sixteen others are taking the standard N. E. L. A. engineering course.

Fond du Lac, Wis.—Classes of instruction have been established by the Eastern Wisconsin Electric Company in this city and Oshkosh for the purpose of further educating its employees in the matter of public relations so that the spirit of service to customers will be paramount. The company will provide its employees with special courses of reading matter giving suggestions on winning and keeping public good will. Arrangements have been made for a series of monthly meetings at which prominent men of the organization will address the employees along this line. The special courses are provided by the N. E. L. A. and explain various public utility questions.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
from All Parts of the World

Hydro-Electric Development and Steam Equipment

Development in Powdered-Fuel Firing. — J. S. ATKINSON. — The author contrasts the turbo-pulverizer unit with the central system, and answers numerous criticisms of powdered-fuel firing. Among the criticisms discussed are the high first cost of plant, high running costs, both for replacements and for power required, danger of complete stoppage and the danger of explosion or slow combustion of the fuel, the ground space taken up by the plant, the noise of the grinding machinery, and the ejection of ash from the chimney top.—*Electrical Times* (*England*), Nov. 8, 1923.

Condenser-Tube Corrosion. — The problem of the corrosion on condenser tubes is primarily a concern of the chemist and metallurgist as a chemical reaction is involved. The possible prevention of corrosion, the importance of minor variations and the physical factors of the tube structure are given.—*Engineering* (*England*), Nov. 12, 1923.

Tests of a Powdered-Coal Plant.—H. KREISINGER, J. BLIZARD, C. E. AUGUSTINE and B. J. CROSS.—The results of tests of the pulverized-coal plant of the St. Joseph Lead Company, at Rivermines, Mo., are given. The boiler tests were made on two Stirling boilers, each having 7,688 sq. ft. of heating surface, and the results are given in the accompanying table.—*Technical Paper* 315 *of the Bureau of Mines.*

STEAMING TESTS ON PULVERIZED-COAL BOILER INSTALLATION

Test number	1	*2	†2
Duration, hours	48	119.22	93.28
Condition of coal when burned	Dried	Dried	Undried
Rating, per cent	202	155	155
CO_2	12.9	13.7	13.6
Temperature of flue gas, deg. F.	666	561	567
Temperature of superheated steam, deg. F.	546	525	534
Over-all efficiency of the boilers	74.4	78.8	78.4

* First five days. † Last four days.

Determining the Economical Interval Between Cleanings of Condenser Tubes. —C. E. COLBORN.—Sediment deposited on condenser tubes by cooling water is frequently a matter of continual daily accumulation. The best vacuum obtainable then steadily decreases. The steam consumption of the prime mover, therefore, is gradually increased, representing a loss in dollars, which is balanced against the cost of cleaning tubes. The most economical period between tube cleanings depends upon how fast the sediment is deposited, the cost of the vacuum loss, which varies with the relative load to a large extent, and the cost of cleaning tubes. Economical operation usually requires a seasonal variation in cleaning schedule. —*Power*, Nov. 20, 1923.

Generation, Control, Switching and Protection

Regulation of Voltage in Alternating-Current Distribution Networks.—F. JACOBSEN.—This paper, read at the Electrotechnical Congress in Gothenburg, Sweden, in 1923, discusses the effects of voltage variations for incandescent lamps, heating appliances and synchronous motors for the conditions that prevail in the electrical industry of Norway. It is maintained that the voltage variations should be limited to 4 per cent or 5 per cent. For this variation there is a reduction of about 12½ per cent in the intensity of the light of an incandescent lamp, and this is considered tolerable. The efficiency and power factor of three-phase synchronous motors are not changed appreciably, and the maximum torque is not changed by more than about 7.5 per cent. The efficiency of heating appliances is not affected, and the time for boiling in cooking apparatus is extended only about 8 per cent. Since the voltage variation of the distribution transformers may amount to 1.5 per cent to 3 per cent, it is necessary to limit the voltage variations in the distribution network to about 2 per cent. The power system should be designed with this limit in view. The author also gives a very simple method for predetermining the voltage variations in the distribution network. It is shown that the ratio of voltages at short circuit and no load depends primarily on the length of the transmission line and is practically independent of cross-section and general arrangement. For example, for a length of line of 650 km. to 800 km. and a copper cross-section of 95 sq. mm. to 240 sq. mm. the error resulting from neglecting these factors amounts to only 1.5 per cent. Convenient graphical methods are given. — *Teknisk Tidskrift* (*Sweden*), *Elektroteknik*, Oct. 6, 1923.

Methods of Voltage Control of Long High-Voltage Lines by the Use of Synchronous Condenser.—J. A. KOONTZ, JR.—Inherent characteristics of high-voltage lines and high-voltage transformers, the effect of low-power-factor load on high-voltage lines as to limiting capacity, the uses of condenser for increasing line output and obtaining good voltage control, and the characteristics which must be met by generators, condensers and regulating equipment in order to control properly voltage over all operating conditions, are considered in this paper.—*Journal of A. I. E. E.*, December, 1923.

Transmission, Substations and Distribution

Alternating Current for 380/220-Volt Farm Installation. — V. FAABORG-ANDERSON.—The paper, read at the Electrochemical Congress in Gothenburg, Sweden, 1923, discusses several problems incidental to the introduction of alternating current to three-phase, 380/220-volt farm installations in Denmark. This voltage is used to a considerable extent at the present time. The author gives very extensive statistical information concerning accidents that have occurred in various alternating-current and direct-current installations. This information is of considerable general interest, but it must be reviewed in its entirety if used as a basis for general conclusions. Details of specific installations are given to show the progress that has been made. —*Teknisk Tidskrift* (*Sweden*), *Electrotecknik*, Oct. 6, 1923.

Electrical Apparatus for High-Tension Power Transmission.—S. Q. HAYES. —A general instructive and descriptive article continued from the November issue on the electrical equipment involved in high-tension power transmission. In this issue bushings, oil circuit breakers, disconnecting switches, lightning arresters and arrangements of transformers are considered.—*Electric Journal*, December, 1923.

Leakage Flux Between Parallel Pole Cores of Circular Cross-Section.—B. HAGUE.—Some of the formulas used by designers for the purpose of calculating the leakage flux passing between circular pole cores in salient-pole machines are far from satisfactory, since they cause the flux to be considerably underestimated. The author draws attention to formulas and curves from which the permeance of the leakage paths can be found with high accuracy, the results being derived by simple mathematical methods. A critical comparison of the old with the new formulas is given, illustrated by a numerical example to show the use of the new results in practice.—*Journal of Institution of Electrical Engineers* (*England*), October, 1923.

Units, Measurements and Instruments

Test Results on the Performance of Suspension Insulators in Service.—C. F. BENHAM.—Megger test results on suspension insulators on the lines of the Great Western Power Company, covering records since 1908, giving the percentage of depreciation by districts—that is, mountain, valley and coast conditions—are given. These results also oover various types of insulators.—*Journal of A. I. E. E.*, December, 1923.

Mercury-Vapor Pumps. — H. P. WARAN.—The rapid production of high vacua is becoming increasingly necessary, and the mercury-vapor pump ac-

complishes this efficiency and rapidly. After discussing some of the drawbacks of the mercury-vapor pumps now on the market, the author describes improvements to the Volmer pump, which has proved very satisfactory.—*Journal of Scientific Instruments (England)*, November, 1923.

Illumination

Temperature and Brightness of Tungsten Lamps.—W. E. FORSYTHE.—After some general remarks on the brightness and temperature of incandescent lamp filaments, the author describes the three different ways of measuring brightness of tungsten. Valuable data are given in four tables in the article.—*General Electric Review*, December, 1923.

Lighting of Large Dry Goods and Department Stores.—The revised issue of this bulletin now includes new illustrations of typical installations conforming to modern standards, a table of desirable intensity of illumination and a discussion of the choice of reflecting and diffusing equipment. Particular emphasis is laid on developments which have taken place in the last two years.—*Bulletin L. D. 132 of the Edison Lamp Works of the General Electric Company.*

Motors and Control

Magnetic Fields of Three-Phase Induction Motors.—F. J. TEAGO.—In dealing with the subject of stator and rotor windings it has been usual to describe a coil in terms of its slot pitch—that is, in terms of the number of slots spanned by the coil. The author feels that a certain amount of confusion arises when it is attempted to describe windings in terms of "pitch," and it is proposed to use the terms "normal distribution" and "super-distribution," which are definite and lend themselves to very simple mathematical representation. A case of normal distribution of the winding is one in which the windings of one phase are put into a number of consecutive slots per pole equal to the actual number of stator slots per pole per phase and where no other phase windings are interwoven with them. It is shown that with one coil side per slot there is little benefit to be derived from a departure from a normal distribution of the winding, but that with two coil sides per slot super-distribution is useful. The changes in the flux density and magnetizing current, with changes in the number of poles, are discussed, together with their bearing upon the phenomenon of crawling.—*Journal of Institution of Electrical Engineers (England)*, October, 1923.

Starting of Polyphase Squirrel-Cage Motors.—B. F. BAILEY.—The different methods of starting polyphase induction motors are briefly reviewed and the speed-torque curves obtained with various types are considered. The effect of starting current upon line voltages, upon the motor and upon connected apparatus is taken up. It is shown that the performance of the compensator is poorer than ordinarily assumed and that the effect upon the line voltage is less with a resistance starter than with a compensator. It is also shown that the heating of the motor is least when thrown directly on the line. The energy required with the various methods is also considered. In large installations it is shown that the considerations involved are radically different.—*Journal of A. I. E. E.*, November, 1923.

Electrophysics, Electrochemistry and Batteries

Non-Arcing Metals.—H. YAGI and H. OYAMA.—After a brief review of the research that has been made on arcing and non-arcing metals, a description is given of investigations in which the authors made a oscillographic study of instantaneous phenomena and found out the existence of two distinctly different phases of discharge between copper electrodes. The factors which seem to have connection with the non-arcing quality of certain metals are discussed.—*Journal of Institute of Electrical Engineers of Japan*, September-October, 1923.

Electric Storage Battery.—H. E. DANCE.—The paper opens with a reference to the early failure of the electric battery vehicle and to the misconceptions which exist as to its proper duty. The battery is not dealt with in detail, but a table showing the characteristics of the two chief types is included, while the motor is dealt with by a brief reference to the main factors controlling its design. The question of transmission is discussed at length, as is also the subject of control. Under the heading of transmission special circumstances affecting differential action are noted. As information regarding the methods of charging is not readily accessible, it was decided to devote a section to this subject, which is probably of greater interest to the user than is the battery itself. —*Journal of Institution of Electrical Engineers (England)*, October, 1923.

Traction

Concrete for Electric Railways.—D. A. TOMLINSON.—The author discusses the methods, designs and uses of concrete for conduits, substations, concrete ties, stations and freight terminals, carhouses, subways, tunnels, bridges and trestles.—*Electric Traction*, December, 1923.

Automatic Fault Localizing on Electric Railways.—H. LUTHY.—A new system of fault localizing is described, and it is shown that the difficulty in the application of the simple motor-load relay protection to an intricate network can be easily overcome by this system. The line sections in each station on the network are connected to a bus-bar by means of electrically remote-controlled oil switches, the latter being assembled in separate switching stations. This interconnection permits any section to be isolated without disturbing the rest of the line. The arrangement of the equipment is described on the basis of the electrified section of the Swiss Federal Railways on the line from Sihlbrugg to Zurich, where the system was applied.—*Electrical Review (England)*, Nov. 16, 1923.

Telegraphy, Telephony, Radio and Signals

Modes of Resonant Vibrations of Telephone Receiver Diaphragms.—J. T. MACGREGOR-MORRIS and E. MALLETT.—The well-known phenomenon of the "howling telephone" is extended by the insertion between the microphone and the receiver of a valve amplifier. The extended phenomenon is used to measure the velocity of sound. An investigation is made as to which member of the complicated mechanical-electrical system determines the pitch of the "howl." Sand figures are obtained of some of the various modes of vibration of a receiver diaphragm. The frequencies of the various modes are compared with those predicted by theory. As a result of these studies the author concludes that the characteristic note is determined by the telephone receiver and that receiver diaphragm overtones are substantially in accordance with the plate theory.—*Journal of Institution of Electrical Engineers (England)*, October, 1923.

Recent Developments in Telephone Equipment for Train-Dispatching Circuits.—W. H. CAPEN.—This paper presents in detail the recent developments in telephone equipment for train dispatching, including a brief outline of its history up to the present time, the transmission requirements of dispatching circuits, together with the effect of the electrical characteristics of the line, number of sets, etc., on the proper design for maximum efficiency; diagrams showing the circuits for the dispatchers' and way-station sets; the development of the vacuum-tube amplifier with loud speaker for both dispatcher and way-station use; diagrams and photographs illustrative of the apparatus discussed; discussion of the practical application and limitations of the present train-dispatching apparatus. An appendix follows giving in detail the development of certain mathematical formulas used in the design of the apparatus.—*Electrical Communication*, Vol. II, No. 2.

Applications of Long-Distance Telephony on the Pacific Coast.—H. W. HITCHCOCK.—The author deals with the general problem of providing long-distance telephone service on the Pacific Coast. A description of the present toll plant is given and the applications which have been made of recent developments in telephone practice are illustrated. Reference is made to the extensive use which has been made of carrier telephone and telegraph systems, and the many special problems, such as the loading of long-toll entrance cables, which these systems introduce are pointed out.—*Journal of A. I. E. E.*, December, 1923.

News of the Industry

Chronicle of Important Events and General Activities, Announcements and Reports of Association Meetings, Court Decisions and Commission Rulings and News of Electrical Men

Atlantic City Chosen

N. E. L. A. Convention Will Be Held at Famous Resort in the Week Beginning May 19

AT THE recent meeting of the executive committee of the National Electric Light Association in New York it was decided to hold the annual convention of the association for 1924 at Atlantic City during the week beginning Monday, May 19. The convention will be held at Young's Million-Dollar Pier, and the manufacturers have arranged to hold an exhibition at the pier during the week.

For some time it was felt that the convention might possibly be held at Philadelphia, but the convention committee being unable to secure sufficient hotel accommodations in that city, it was eliminated.

Central-Station Christmas Message Put on the Radio

President Charles L. Edgar of the Edison Electric Illuminating Company of Boston broadcasted a Christmas message on Monday, Dec. 24, to central-station executives and their public—arrangements having been made to reach practically all parts of the United States, including Alaska and Hawaii. Advance notices of the time of his talk, which was made at 10 p.m., were sent to about a hundred central-station executives. The co-operation of the Westinghouse and General Electric broadcasting stations and the American Telephone & Telegraph Company made it possible to have the broadcasted message reach so large an audience.

This idea of broadcasting the central station's story, or personality, to the public was strongly urged editorially in the ELECTRICAL WORLD for Dec. 8.

Mr. Edgar said in part:

"When I was told that my message tonight would, within the space of a few moments, be heard throughout our North American Continent, including the farthest reaches of Alaska and Hawaii, it brought home to me with tremendous force how great is our advancement today. This advancement has come almost without our realizing it.

"Forty-five years ago a brightly burning electric arc lamp attracted curious crowds; the incandescent electric lamp was a rare novelty. The telephone as we know it was in its experimental stages. Inventors were feeling their way in the application of this electric force. And since those pioneer days, by rapid stages, have come the improvements, the increasing knowledge of what electricity can do and the working out of wireless and its control until now it is possible for me to stand here in Boston on one edge of the United States and speak to a great audience distributed among 135 millions of people.

"This one remarkable development alone in the use of electricity would make this a merry Christmas—a Christmas filled with inspiration, not only because it is the Christmas time, but because the great mass of eager, earnest, faithful workers in the world have literally taken to heart and put into actual practice the divine privilege granted to man—to rule the world."

Griffith Becomes First Vice-President of N. E. L. A.

Franklin T. Griffith, president of the Portland (Ore.) Railway, Light & Power Company, has been elected first vice-president of the National Electric Light Association to succeed the late John A. Britton of San Francisco. Mr. Griffith was formerly vice-president of the association, but resigned prior to the last convention owing to pressure of work. Mr. Britton was elected to succeed him, and when he died last summer it became necessary to replace him by another vice-president, preferably from the Pacific Coast. Mr. Griffith was chosen again and was finally prevailed on to accept the appointment. Mr. Griffith has always taken an active interest in N. E. L. A. affairs and for many years was chairman of the association's important water-power committee.

F. T. GRIFFITH

New Muscle Shoals Offer

Southern Power Companies May Combine in Bid of $100,000,000 on Fifty-Year Lease

IT IS understood in Washington that a large group of the Southern power companies have concluded an arrangement under which they intend to make an offer to the government to lease the Muscle Shoals developments for a period of fifty years and will pay the government approximately a hundred million dollars.

The negotiations now going on with the government, it is understood, are at the instance of Representative Harry E. Hull of Iowa, who inquired of the Federal Power Commission the money value to the people of the United States of the power to be produced at Muscle Shoals. Mr. Hull, it is said, desired to contrast the amount of the potential power and its possible money value with the offer made last winter by Mr. Ford of $5,000,000 for all of the government's property at Muscle Shoals—an offer made, it will be recalled, before the War Department sold the Gorgas steam plant for $3,500,000. It is understood in Washington that Mr. Hull took the step he did in order to bring out the actual value of the power to come from the Wilson Dam and that he was led to do this by the introduction in the House of Representatives of the so-called Madden and McKenzie bills, which provide for the turning over to Mr. Ford not only of all the government property at Muscle Shoals, but of all the water-power rights at Wilson Dam and other dams in case they should be built.

It is further understood in Washington that the group of Southern power companies which are to offer the hundred million dollars for the fifty-year lease of the Wilson Dam intend also to make an offer to the government to purchase the Sheffield steam plant for approximately $4,500,000 in cash.

The prospective offer of the Southern power companies, it is understood, will reserve 100,000 hp. for the manufacture of nitrates for fertilizer by the use of the Casale process now being established in this country.

Superpower Conference to Be Held in Washington

Secretary Hoover of the Department of Commerce has called another conference on superpower, to be held in Washington on Jan. 5. At this meeting the delegates appointed by the governors of the various states will be in

attendance, as well as those appointed by utility companies. The program for the meeting will be prepared by Secretary Hoover with the aid of the public service commissioners of the ten Northeastern states most interested in superpower.

Record-Breaking "Tie-in" on New York's Systems

On Tuesday, Dec. 11, the 25-cycle and 60-cycle power systems of the New York Edison Company and the United Electric Light & Power Company were tied together at the Hell Gate station of the latter company. This "tie-in" was accomplished by means of a General Electric 35,000-kw. induction synchronous-type frequency converter, establishing a record in frequency-converter ties and representing a total of 727,000 kva. working in synchronism on the two systems.

The kilowatt capacity of this set is nearly three times that of the largest frequency converter previously built and marks a new epoch in the construction of horizontal-shaft alternating-current machines. The induction unit is the largest induction motor in the world and has a continuous rating of 37,000 kva. The synchronous generator, rated at 25,000 kva., is larger than any horizontal-shaft, salient-pole generator previously constructed. The installation, the manufacturer says, includes also the largest air-blast transformer in the world.

Stone & Webster Companies Hold Sales Conference

Executive and sales representatives of the Blackstone Valley Gas & Electric Company, Pawtucket, R. I.: Connecticut Power Company, New London; Edison Electric Illuminating Company of Brockton, Mass.; Electric Light & Power Company of Abington & Rockland, Mass.; the Boston office of Stone & Webster, Inc., and the Lowell Electric Light Corporation, together with New England gas companies operated by Stone & Webster, met recently at New London, Conn., for a sales conference, with headquarters at the Mohican Hotel in that city.

Among the talks of electrical interest on the program were the following: "How to Pick Salesmen," Ralph H. Williams, Boston; "The Management's Viewpoint of the Sales Department," J. L. Alexander, Haverhill, Mass.; "Dealer Co-operation," F. M. Feiker, vice-president Society for Electrical Development, New York; "How to Increase Kilowatt-Hour Consumption per Residential Meter," N. T. Wilcox, Boston; "Sales Promotion," R. R. Johnson, Pawtucket; "Advertising Versus Man Power," S. E. Choquette, Pawtucket, and B. R. Farrand, New London; "Merchandising Electrical Heating and Cooking Devices," A. J. Williams, Brockton; "Public Relations," R. G. Custer, Lowell; "The Value of the Woman's Viewpoint in Our Business," Mrs. M. V. Martin, Pawtucket; "Commercial Lighting Potentialities," F. C. Eteson, Pawtucket. Other speakers were V. E. Bird, manager Connecticut Power Company; H. H. Hunt, H. T. Edgar, M. L. Sperry and A. S. Pratt of the Stone & Webster executive organization, Boston; E. L. Milliken, Roger A. Gordon, F. K. Simmons and E. C. Tuite of the Blackstone Valley company.

Six-Million-Dollar Program of Tennessee Electric Power

The Tennessee Electric Power Company, which has now under construction a 20,000-kw. steam plant at Hales Bar on the Tennessee River, has recently purchased a second unit of the same size to be installed as soon as received. This will give this steam plant a capacity of 60,000 hp. It will operate in conjunction with the 60,000-hp. water station at the same location. The estimated cost of the steam additions is $4,000,000. Plans call for the completion of the first unit about May 1 and the second unit July 1, 1924.

Work is now in progress also on the installation of an additional 22,200-hp. unit at the company's Great Falls hydro-electric station near the town of Rock Island, 75 miles southeast of Nashville. This unit is of the vertical type. In connection with its installation a tunnel 600 ft. long is being built together with a new intake house and duplicate facilities to correspond with the 13,000-hp. unit in operation. The height of the dam at this development is being increased 35 ft., which necessitates building it up with concrete and raising the Taintor gates, which are now on top. The total cost of this work is estimated at $2,000,000. The installation of the new unit is scheduled for completion Nov. 1, 1924, and the dam for May 1, 1925.

The work of constructing a duplicate 120,000-volt line from Cleveland to Knoxville has been practically completed. This work cost approximately $370,000. Work was recently completed on the 15-mile extension of 22,200-volt lines into the town of Tellico Plains, serving a quarry which mines slate. A line has been built from Lenoir City into Friendsville to serve several marble quarries in that vicinity. Construction work has been started on an extension of power lines from Mascot, above Knoxville, into the town of Jefferson City.

Vice-president B. C. Edgar announced very recently that plans for expansion next year called for an expenditure of $5,000,000 or more. He said the proposed hydro-electric plant on the Ocoee River in Polk County would follow the completion of the Hales Bar steam plant and the development under way at Rock Island and that the company fully expected the work on the Ocoee to begin in 1924. This development will mean the building of a 24,000-hp. hydro-electric plant.

New York Commission Adopts Uniform Account System

The Public Service Commission of New York State on Dec. 19 adopted the uniform system of accounts for gas and electric corporations subject to its supervision as recommended by the National Association of Railway and Utilities Commissioners at its meeting in Detroit in November, 1922, with certain modifications necessary to adapt the system to New York State practice. The commission has been considering the adoption of the system for more than a year, and on Oct. 31 a public hearing was held at Albany attended by officials of leading electric and gas companies operating in the state. The new system of accounts will apply to all corporations under jurisdiction of the commission with operating revenues of $10,000 or more.

While the commission is obliged by law to give six months' notice in changing the system of accounts of a public service corporation, and the order of the commission therefore does not require compliance with its terms until July 1, 1924, it is announced at the office of the commission that nearly all of the corporations affected will install the new system of accounts on Jan. 1. The system has been adopted in Illinois, Wisconsin, Utah, Pennsylvania, Michigan and other states, and it is the aim of the National Association of Railway and Utilities Commissioners to have it adopted by all states. Accompanying the order the Public Service Commission of New York has issued a pamphlet of more than 100 pages setting forth in detail the various ramifications of the new system.

Illinois Public Service Valued at $60,759,000

The property value behind the par and no-par common stock of the Public Service Company of Northern Illinois, as of Jan. 1, 1923, was $131 per share, according to a computation just made by the Illinois Commerce Commission relative to the value of the company's properties "used and useful" in the public service and also based upon the value of certain other properties not included in the commission's valuation.

The Commerce Commission, after an exhaustive inquiry, fixed a valuation of $60,759,000 as a basis for rate-making purposes. The commission's valuation did not include certain valuable assets of the company which were not used in the actual rendition of service. Among the properties not included were the Hickory Creek, Jackson Creek and Marseilles water-power sites, securities owned, property represented by expenditures on the new Waukegan generating plant, sinking funds, insurance funds, properties leased to other companies and investments in affiliated companies, including the company's coal properties. These assets are valued by the company at $8,088,255, bringing the total to $68,847,255.

Transportation Midwinter A. I. E. E Theme

Railroad Presidents and National Leaders Will Talk to Nation-Wide Audience—Fortieth Anniversary of Institute to Be Celebrated—The Technical Program

RAILROAD presidents will talk on national transportation problems, railroad operating executives will depict the engineering features of modern transportation systems, the new Moore School of Electrical Engineering at the University of Pennsylvania will be dedicated, the university will confer honorary degrees on several engineers, the Edison medal for 1923 will be presented to John W. Lieb, and, finally, the fortieth anniversary of the American Institute of Electrical Engineers will be commemorated—these will be the outstanding features of the midwinter convention of the Institute in Philadelphia on Feb. 4-8, 1924, and it is confidently expected to be the biggest convention ever held by electrical engineers.

By wire and radio from Chicago, Boston, New York and Washington such men as President Markham of the Illinois Central, President Maher of the Norfolk & Western, President Budd of the Great Northern Railway and Vice-president Buckland of the New York, New Haven & Hartford on the evening of Tuesday, Feb. 5, will address a nation-wide audience in addition to the thousands that will pack the Metropolitan Opera House in Philadelphia. These men and others whose names are known throughout the nation will present the facts about modern transportation and its influence on industrial and social wellbeing, and will outline constructive plans for still greater developments. A Cabinet member and a prominent industrial leader will also contribute constructive views on transportation and its relation to the nation's welfare.

INSTITUTE'S FORTIETH ANNIVERSARY

On Monday evening, Feb. 4, the story of the development of a profession which started only forty years ago and now ranks in accomplishment and influence with any in existence will be told. Members of the small group of electrical engineers who formed the pioneer organization of the Institute will speak. Elmer Sperry, Elihu Thomson, T. C. Martin and J. J. Carty will give inspiration to the younger generation of electrical engineers by addresses illumined by their association with electrical developments since the inception of the present-day art. This will be followed by the presentation of the Edison medal to John W. Lieb.

To add variety to the meetings and to recognize the basic influence of education on engineering developments, the Institute members will be honorary guests of the Moore School of Electrical Engineering at the University of Pennsylvania on the afternoon of Feb. 6. This school is unique in being the only school of electrical engineering handsomely and separately endowed as a part of a great university, and it will be dedicated fittingly by the Institute to the cause of electrical education. To show its appreciation of the accomplishments of electrical engineers the University of Pennsylvania will confer several honorary degrees at this time.

Another interesting event will be the trip planned for Friday afternoon to the works of the Bethlehem Steel Company. After viewing the activities of this great plant the visitors will be entertained at Lehigh University as guests of the Lehigh Valley Section of the Institute.

THE TECHNICAL SESSIONS

Chairman William C. L. Eglin of the convention committee and Chairman L. W. W. Morrow of the meetings and papers committee have not, however, neglected the technical side of electrical engineering in arranging the convention program. In all nine technical sessions will be held, at which more than forty papers will be presented and discussed. These will cover transmission, superpower, industrial applications of electricity, electrical machinery and electrophysical subjects; they will be presented by authorities on the respective topics, and the discussions are sure to be animated, instructive and full.

Card parties, shopping trips, teas, dances and entertainments will be held with the view especially of entertaining the ladies who will accompany the delegates, these social features reaching their climax in the annual dinner-dance on Thursday night. Headquarters will be at the Bellevue-Stratford Hotel.

Program for Midwinter Convention A. I. E. E.

MONDAY, FEB. 4

Morning—Registration and committee meetings.

Afternoon — Technical session: "Economics and Limitations of the Superpower Transmission System," Percy H. Thomas; "Some Theoretical Considerations of Power Transmission," C. L. Fortescue and C. F. Wagner; "Power Transmission, F. C. Hanker; "Power Limitations of Transmission Systems," R. D. Evans and H. K. Sels; "Experimental Analysis of the Stability and Power Limitations of Transmission Systems," R. D. Evans and R. C. Bergvall; "Limitations of Output of a Power System Involving Long Transmission Lines," E. B. Shand.

Evening—Celebration of the fortieth anniversary of the Institute. Speakers: General John J. Carty, Prof. Elihu Thomson, Elmer A. Sperry and T. Commerford Martin; presentation of Edison medal to John W. Lieb.

TUESDAY, FEB. 5

Morning—Technical session: "Gaseous Ionization in Built-up Insulation—II," J. B. Whitehead; "Overdamped Condenser Oscillations," C. P. Steinmetz (deceased); "Free Convection of Heat in Gases and Liquids—II," C. W. Rice; "Magnetic Properties of the Ternary System Fe-Si-C," T. D. Yensen; "Alkali-Vapor Detector Tubes," H. A. Brown and C. T. Knipp.

Afternoon and Evening—Addresses on the operating aspects of railroad transportation, and a "transportation meeting" at Metropolitan Opera House. Among the speakers will be Ralph Budd, president Great Northern Railway Company; N. D. Maher, president Norfolk & Western Railway; C. H. Markham, president Illinois Central Railroad; Edward G. Buckland, vice-president New York, New Haven & Hartford Railroad, and L. G. Coleman, assistant general manager Boston & Maine Railroad. (Other speakers to be announced later.)

WEDNESDAY, FEB. 6

Morning — Technical session (A): "Transient Performance of Electric Elevators," David Lindquist and E. W. Yearsley; "Variable-Voltage Control Systems for Elevators," E. M. Bouton; "A Novel Alternating-Current Voltmeter," L. T. Wilson; "Oscillographic Study of Voltage and Current in Permeameter Circuit," W. B. Kouwenhoven and T. L. Berry, Jr.; "Power-Plant Auxiliaries—Their Relation to Heat Balance," A. L. Penniman, Jr.

Morning — Technical session (B): "Shaft Currents in Electric Machines," P. L. Alger and H. W. Samson; "Eddy-Current Losses in Armature Conductors," R. E. Gilman; "Tooth Pulsations in Rotating Machines," T. Spooner; "Surface Iron Losses, with Reference to Laminated Materials," T. Spooner and I. F. Kinnard.

Afternoon—Dedication of the Moore School of Electrical Engineering at the University of Pennsylvania.

Evening — "Transmission at 220,000 Volts," Frank G. Baum; entertainment and dance.

THURSDAY, FEB. 7

Morning — Technical session (A): "Method of Testing Current Transformers," F. B. Silsbee; "Recent Developments in Kilovolt-Ampere Metering," B. H. Smith and A. R. Rutter; "Automatic Transmission of Power Readings," B. H. Smith and R. T. Pierce; "Quadrant Electrometer for Measurement of Dielectric Loss," D. M. Simons and W. S. Brown.

Morning—Technical session (B): "Recent Advances in the Manufacture and Testing of Static Condensers in Power Sizes," R. Marbury; "Effect of Time and Frequency on Insulation Tests of Transformers," V. M. Montsinger; "Insulation Tests of Transformers as Influenced by Time and Frequency," F. J. Vogel; "Short Circuits of Alternating-Current Generators," C. M. Laffoon.

Afternoon—Technical session: "Economic Development of Step-by-Step Automatic Telephone Equipment," P. G. Andres; "High-Quality Transmission and Reproduction of Speech and Music," W. H. Martin and H. Fletcher; "Function and Design of Horns for Loud Speakers," C. R. Hanna and J. Slepian; "Certain Factors Affecting Telegraph Speed," H. Nyquist.

Evening—Annual dinner dance.

FRIDAY, FEB. 8

Morning — Technical session (A): "Measuring Methods for Maintaining the Transmission Efficiency of Telephone Circuits," F. H. Best; "Radio-Telephone Signaling—Voice Frequency," C. S. Demarest, M. L. Almquist and L. M. Clement; "Telephone Transformers," W. L. Casper; "An Electrical Frequency Analyzer," R. L. Wegel and C. R. Moore.

Morning — Technical session (B): "Multiple System of Cooling Large Turbo-Generators," D. Bratt; "An Experimental Study of Ventilation of Turbo-Alternators," C. J. Fechheimer; "Importance of Brush Mounting," P. C. Jones; "Transformers with Tertiary Windings," A. Boyajian.

Afternoon—Visit to Bethlehem Steel Company's plant.

Evening—Entertainment and visit as guests of Lehigh Valley Section at Lehigh University.

Plans for Spring Convention of A. I. E. E.

Birmingham, Ala., will be the location for the spring convention of the Institute, and the date will be April 7-11. The hearty co-operation of the local committee in Birmingham with the meetings and papers committee has brought about plans for a program which should attract electrical engineers from all parts of the country.

Hydro - electric developments and equipment, high-tension transmission lines and equipment, electric furnaces, oil circuit breakers, operation of interconnected systems, high-tension insulation, lightning arresters and relays are some of the topics which will be treated. It is planned to have authoritative papers presented on these topics by men representing the practices and opinions of all sections of the country, so that very profitable discussion should result.

As a feature of the convention it is planned to hold a meeting on the electrical development of the South—what it has meant and what it will mean. Industrial leaders, legislators and utility executives will talk on various aspects of this topic, and sufficient acceptances have already been received to warrant the promise of a successful meeting.

Local League Organization Committee Begins Work

W. E. Robertson, vice-president of the Robertson Cataract Electric Company, Buffalo, who was chairman of the conference of representatives of local electric leagues held on Association Island last September, has appointed the following committee to develop a plan for a national organization of local electric leagues. Charles A. Collier, Georgia Railway & Power Company, Atlanta; M. A. Curran, manager Western Electric Company, Cincinnati; R. E. Fisher, vice-president Pacific Gas & Electric Company, San Francisco; Joseph Fowler, president Fowler Electric Company, Memphis; J. E. North, commercial agent Cleveland Electric Illuminating Company; L. L. Strauss, New York; Earl E. Whitehorne, commercial editor ELECTRICAL WORLD, New York, chairman.

The committee was authorized by the conference to make a thorough study of existing local electric leagues, their organization and activities, and also of the organization plans of other national affiliations of local associations, such as the Rotary clubs, Kiwanis and the National Federation of Women's Clubs, and develop a plan for the national affiliation of local electric leagues that will provide for organized co-ordination and co-operation to strengthen and promote the league movement and make available to all the experience and achievements of successful leagues. This organization plan will be submitted for their information to all the national group associations of the electrical industry and brought before the next league conference, which is to be held in September, 1924, on Association Island.

American & Foreign Power Stock Quickly Sold

The 400,000 shares of preferred stock with a bonus of the same number of shares of common stock offered by the newly formed American & Foreign Power Company, Inc., last week were very quickly oversubscribed. Allotments, it was announced, will probably range between 15 and 20 per cent of subscriptions. Demand for the securities from abroad was much greater than had been expected by the syndicate offering them. With the sale of this stock the outstanding capitalization will consist of 400,000 shares of $7 cumulative preferred stock, 120,000 shares of $7 cumulative second preferred stock and 920,000 shares of common, of which 520,000 will be held by the Electric Bond & Share Company.

Before the formation of the American & Foreign Power Company, Inc., the Electric Bond & Share Company had acquired operating public utility properties in Cuba, Panama and Guatemala at a purchase price aggregating $13,114,213. These properties are now supplying electric light and power, telephone or other services to over thirty - nine communities in Cuba, Panama and Guatemala. All these properties have been successful, and for the year ended Aug. 31, 1923, earned $2,088,900 net. The American & Foreign Power Company, Inc., will take over and operate these properties.

General Electric to Aid Pure Research in Germany

According to recent announcement by E. W. Rice, Jr., honorary chairman of the board of directors, General Electric Company, Schenectady, N. Y., this company has arranged for the assistance of pure electrophysical research in Germany for one year under a committee consisting of the eminent and well-known scientists Max Planck, Professor Haber, Drs. Nernst, Laue and Franke.

The money is to be employed for the purchase of apparatus and material and must not be used to relieve the government of its duty of properly maintaining a laboratory. It is also to be used for the remuneration of coworkers and assistants. It is not to be used for the solution of problems of direct industrial use, such as specified technical processes.

The company has also arranged to place a small fund at the disposal of Dr. Nernst, who is director of the Technisches Reichsanstalt in Berlin, for a study of the electric phenomena preceding and accompanying the breakdown of insulators. This is a problem on which Dr. Steinmetz was at work, but even had he lived, competition would have been useful in the achievement of the results sought for.

The result of the work of these German scientists is to be made public for the general good of all. Their work, while financed by and to a certain extent in co-operation with the General Electric Company, will not be the property of that concern in any sense, but will be published in full.

Successful Pioneer Illumination of Football Game

BY FLOODING the football gridiron with light from eight 18-in. searchlamps and fifty "L-15" projectors mounted 42 ft. above the ground at the General Electric Company employees' athletic field in Lynn, Mass., Nov. 21, the first thoroughly successful night football game to be played in the world, so far as is known, was enjoyed by a crowd of five thousand enthusiasts who were invited to the contest. The General Electric student engineers' and Tufts College second elevens played a tie game under an illumination varying from about 4 foot-candles in the center of the field to about 1.25 foot-candles at the sides. All the lamps used consumed 1,000 watts each at 110 volts and were of the gas-filled type. Football coaches from many athletic centers attended and were loud in their praise of the installation. Energy was supplied by the Lynn Gas & Electric Company.

Dickinson Bill on Muscle Shoals

Measure Thought to Have the Support of Representative Madden and Other Republican Leaders Sanctions Fifty-Year Lease to Ford—Fertilizer Project Prominent

REPRESENTATIVE MADDEN of Illinois, Republican leader in the House of Representatives, and others influential in the majority party are understood to favor the passage of the bill (H. R. 3222) introduced by Representative Dickinson of Iowa to lease to Henry Ford for fifty years the government nitrate plants and dams at Muscle Shoals, Ala. As stated in the ELECTRICAL WORLD last week, by the terms of this bill the operations at Muscle Shoals would come under the provisions of the water-power act, administered by the Federal Power Commission. The measure provides that the government is to receive an annual return of 6 per cent on its actual expense of constructing the dam and other project works, exclusive of navigation facilities, with the proviso that only 3 per cent need be paid for that portion of the facilities used in the production of commercial fertilizers. A summary of the other chief provisions of the measure follows:

GORGAS PLANT ELIMINATED

The Secretary of War is empowered to accept the offer of Henry Ford, as made on May 31, 1922, with the exception of the part relating to the Gorgas plant and transmission line. Mr. Ford must form a corporation in which $10,000,000 must be paid in in cash, to be controlled by the company. The lease is to run for a period of fifty years from the date when structures and equipment sufficient to generate 100,000 hp. shall have been completed. At the end of that calendar year the first payment of $200,000 must be made. Thereafter $500,000 must be paid annually for a period of five years.

The government is to complete Dam No. 2, acquire necessary lands and flowage rights and install equipment up to a capacity of approximately 600,000 hp. Maintenance of the power house, machinery and other appurtenances is to be at the expense of the company. Maintenance of the dam is to be the responsibility of the United States. Energy not to exceed 200,000 hp. is to be delivered for the operation of the locks. The proposed site for Dam No. 3 is to be held open to the company for a period of three years, during which time it is to have preference in the matter of a water-power license.

For an annual rental of one dollar the company may lease all of the property constituting Nitrate Plant No. 2 and be privileged to use any and all of the patents, processes, methods and designs which the government has acquired, together with the sulphuric-acid units now in storage on the premises. Practically the same conditions apply to Nitrate Plant No. 1, but the company is not to be obligated to operate the No. 1 plant as a nitrogen-fixation plant. Under the dollar-a-year lease are included also the property and appurtenances at the Waco quarry. The company is obligated to manufacture nitrogen and other commercial fertilizers, "mixed or unmixed and with or without filler, according to demand, at Nitrate Plant No. 2 or its equivalent."

FERTILIZER RESEARCH IMPOSED

A further condition is "to determine by research whether by means of electric furnace method and industrial chemistry there may be produced, on a commercial scale, fertilizer compounds of higher grade and at lower prices than farmers and other users of commercial fertilizers have in the past been able to attain, and to determine whether in a broad way the application of electricity and industrial chemistry may accomplish for the agricultural industry of the country what they have economically accomplished for other industries and, if so found and determined, to reasonably employ such improved methods."

The profit on the fertilizer products is not to exceed 8 per cent. The fertilizer production is to be under the supervision of a board of not more than nine voting members to be chosen as follows: The American Farm Bureau Federation, the National Grange and the Farmers' Educational and Co-operative Union of America are each to designate not more than seven candidates, in the first instance, and thereafter, for succession in office, not more than three candidates. From this number the President is to nominate not more than seven. The company is to select two voting members of the board. The members of the board are not to draw compensation from the government. A representative of the Bureau of Markets is to serve the board in an advisory capacity.

To insure equitable distribution of the product, the board is empowered to make regulations for its sale. If the board disagrees, the matter is to be referred to the Federal Trade Commission.

GOVERNMENT REGULATION PROVIDED

The company is to operate the project "so as to produce the fullest practicable output of salable electrical energy and must transmit, distribute and sell all surplus energy not used by it in the manufacture of nitrogen or other commercial fertilizers or must enter into contracts for its distribution. The distribution of the power is to be under state regulation or that of the Federal Power Commission. The Federal Power Commission will determine the proportion of power used in the manufacture of nitrogen or other fertilizers and the practicable output of salable electrical energy. It will determine the adequacy of repairs and the necessity of renewals.

At the end of the fifty years the company is to have a preferred right to negotiate for a renewal of the lease. If the terms of renewal offered by the government are not accepted by the company, the conditions of the contract are to remain in effect until the government shall have disposed of the plants and properties to another under terms no less favorable than those offered to the company.

POINTS OF DIFFERENCE SUMMARIZED

The main points of difference between the provisions of the Dickinson bill and those of the original Ford offer are these:

The offer is amended by providing for the completion of Dam No. 2 by the United States.

The period of the lease is made fifty instead of a hundred years.

The annual charge payable for the use of the government property is to include interest, maintenance and depreciation and to be computed on the government investment exclusive of locks and navigation facilities, and a change is made in the schedule of payments for the first six years, increasing them by $1,500,000. The charge is to be cut from 6 per cent to 3 per cent to the extent to which the power is actually used for the production of fertilizers. The original Ford offer proposed to pay 4 per cent on the government investment. A proposed annual charge of $35,000 to reimburse costs of operation of the dam and gates is eliminated.

The provisions of the Ford offer with respect to the construction of Dam No. 3 have been eliminated. It is proposed in the Dickinson bill that the United States shall reserve for a period of three years the site of Dam No. 3, during which time the company shall have a preference right to apply for it under the federal water-power act if the power which can be produced at Dam No. 2 proves insufficient.

By the Ford offer it was proposed that the company should purchase from the United States the nitrate properties at Muscle Shoals and the steam power plant at Gorgas and its transmission line for the sum of $5,000,000. It is proposed by the Dickinson bill that, instead of selling the nitrate properties, the United States shall lease them for the same period as Dam No. 2, that is fifty years, for a nominal annual rental of $1. This change would relieve the Ford company of the payment of the $5,000,000 as originally proposed. In order to protect any investment which the company may make in original plant or in improvements, provision is made in the bill for reimbursement of such expenditures in the manner provided in the federal water-power act, in the event that the lease is not renewed on termination.

From the Ford offer the words "adjacent or near thereto" have been eliminated, in order that no restrictions may be placed upon the location of plants for the production of fertilizers if it should be found desirable to locate them further from Muscle Shoals.

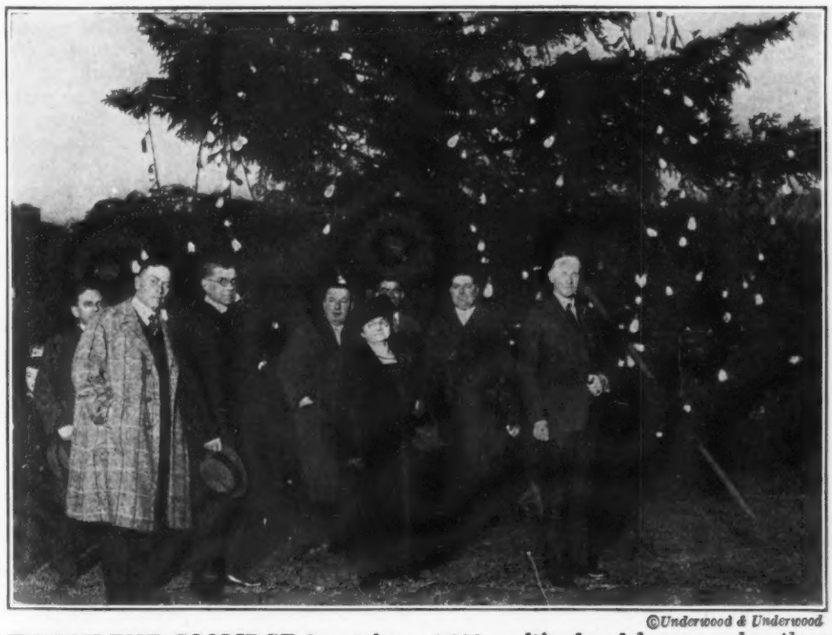
The expression "annual cost," held to be vague in the Ford offer, is clearly defined in the Dickinson bill. The company is required to operate the power properties to their full capacity and to dispose of all surplus energy not used by it in the manufacture of fertilizers or to contract for such disposal. The transmission, distribution and sale of such power is made subject to regulation by public authority, as provided in the federal water-power act, and the company is required to establish and maintain a system of accounts.

The Federal Power Commission is by the terms of the bill to determine certain questions of fact upon which the annual charges would be based, to determine whether the power project is fully operated, and to supervise the maintenance and renewal of power house and equipment. The provisions of the federal water-power act with respect to recompense for headwater improvements are incorporated.

The company is to have a preference right for renewal of lease at the end of fifty years, and if there is not agreement between the company and the United States at that time, the conditions of the existing offer are to remain in effect until the United States shall find a new lessee under conditions no less favorable than those offered to the company. If the properties are leased to another, the company shall be compensated for the fair value not to exceed actual cost of any properties constructed by itself or for any betterments of or additions to existing government property.

The proposed amendment would frankly subsidize fertilizer production by eliminating the proposed cash payment of $5,000,000 and the annual payments for maintenance and sinking fund, by reducing the rate of interest to 3 per cent, by making no charge for the use of the government nitrate properties, and by protecting any investment the company may itself make. If the company really desires to produce nitrates, say the advocates of the Dickinson bill, the amendment is more favorable than the original offer made by Mr. Ford and embodied in former bills.

President Coolidge Lights White House Christmas Tree



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PRESIDENT COOLIDGE has taken much interest in the electrically lighted outdoor tree which was a feature of the Christmas at the White House and personally turned on the lights on Christmas Eve. As stated in these columns last week, this "national" electric Christmas tree was the result of a suggestion from the Society for Electrical Development. The tree was presented by Middlebury College, Vermont, and installed through the co-operation of various electrical men in Washington. The Potomac Power Company hauled the tree from the station and set it up in the "White Lot" south of the White House. The Washington Electrical League furnished and installed all the equipment and the decorations on the tree itself, consisting of 2,000 multi-colored lamps and a three-foot star illuminated by high-candle-power white lights. The Capital Traction Company and the Washington Railway & Electric Company contributed publicity to the event by carrying announcements on the front of all street cars. The ceremonies at the tree on Christmas Eve, attended by about 4,000 people, consisted of Christmas carols and musical selections by the Marine Band.

The first three figures from left to right in the picture are William L. Goodwin, operating vice-president of the Society for Electrical Development, Senator T. L. Greene of Vermont and J. H. Colbeck, treasurer Washington Electrical League. President Coolidge stands to the right.

Before the Power Board

Grays Harbor Company Will Fight Municipality—Renewability of Three-Year Permits

THE Grays Harbor Light & Power Company of Aberdeen, Wash., a concern operated by Sanderson & Porter of New York, has applied to the Federal Power Commission for a preliminary permit covering a project in the Wynooche River at a point 25 miles above Aberdeen. It is planned to build a dam 150 ft. to 170 ft. high. A conduit is to be run to a power house where 10,000 hp. will be developed. The site of the reservoir is covered with a heavy growth of timber. It will be a number of years before the site will be cleared, but the power company has been forced to put in its application by the action of the municipality of Aberdeen in voting a bond issue of $2,000,000 looking to this very development. The power company expects to contest any effort on the part of the municipality to develop this site.

Walter Cravens of Kansas City has applied for a preliminary permit to construct a dam 100 ft. high on the Osage River 8 miles above Bagnell, Mo. The dam will create a pool 125 miles long. The reservoir will cover 65,000 acres. It is the plan to install machinery capable of developing 50,000 hp. The primary power available is 20,000 hp. The entire cost of the project is expected to be in the neighborhood of $7,500,000.

The city of Tacoma, Wash., has applied to the commission for a license to cover a minor portion of its Skokomish River project. In carrying through this large development nine acres of the Olympia National Forest will be flooded. The remainder of the project, which was described in the ELECTRICAL WORLD for Dec. 8, page 1191, does not come within the purview of the Federal Power Commission. The plans involve the construction of a transmission line 40 miles long to carry energy to Tacoma.

RENEWABILITY OF PERMITS

An announcement on the part of an important interest that it expects to file an application for another preliminary permit under the water-power act after having held a preliminary permit for the full three years allowed by the law has led to a study of that situation by the staff of the commission. The conclusion has been reached that the law does not contemplate allowing any one interest to have priority rights for more than three years. It is probable that the commission will be asked to approve a recommendation that no preliminary permit be granted a second time to the same interest. It would be possible, of course, for the applicant to come in at any time after the expiration of his preliminary permit with an application for a license. This situation is being faced at present on the lower Niagara Gorge project, on a Pit River project and on the Dixie projects. Other projects soon will be in the same situation.

Brief News Notes

Motorboat Show to Be Held Next Month.—The nineteenth annual motorboat show in Grand Central Palace, New York, will be held on Jan. 4-12, with a full display of electrical features, including ignition for the engine, searchlamps, cabin lamps, refrigerating sets, pumps, radio and apparatus for steering and for handling the anchor.

Wewoka Sells Plant to Oklahoma Utility.—The election held at Wewoka, Okla., on Dec. 12 resulted in the sale of the local municipal electric light plant to the Central Oklahoma Light & Power Company, a subsidiary of the Oklahoma Gas & Electric Company. Only four votes were cast against this action.

Sixty-two Municipal Plants in Iowa Given Up.—By a unanimous vote the City Council of Little Sioux, Iowa, has agreed to abandon its municipal plant and to receive service from the high-tension line of the Iowa Service Company. The company will build a line from Mondamin, a distance of 7 miles. Little Sioux is the sixty-second Iowa municipality to abandon its electric light and power plant for private service.

Waterloo Central Station Builds New Dam.—The dam built by the Citizens' Gas & Electric Company across the Cedar River at Waterloo, Iowa, at a cost of $250,000, has been completed. This dam, which took the place of a fifty-year-old structure, was begun in August, 1922. It is the intention of the company to build a hydro-electric plant on the east bank of the river in the near future.

Electrical Progress in Houston, Tex.—Operating revenue of the Houston (Tex.) Lighting & Power Company during its fiscal year just closed amounted to $2,465,835, as compared with $2.028.392 last year. Operating expenses were $913,922 as compared with $830,028. These figures are given in the report of S. R. Bertron, general manager. The city of Houston shares in the company's earnings, and this year it will receive $88,348 as its share. Last year the city received $104,746. The decrease is explained by the greater outlay for improvements and betterments.

Maine Engineers to Compile Water-Power Data.—At a recent meeting of the Portland branch of the Maine Association of Engineers a committee of five was named to look into the water-power situation in the state. Its conclusions will probably be submitted to the Legislature. At this meeting Philip W. Blake a consulting engineer of Portland, said: "I ask any man in the room to tell me one reason why it is bad policy to sell water power developed in the state outside the State of Maine." His challenge, says the report, remained unanswered.

Marysville, Ohio, to Resume Street Lighting.—After two years of dark streets, Marysville, Ohio, with a population of 4,000, is about to resume street lighting as the result of a mayoralty campaign waged around that issue. Marysville gets its electric light and power from the Ohio Edison Company, and a contract with that company for street-lighting service has been negotiated on the following terms: For 600-watt lamps, $60 per lamp a year; 250-watt lamps, $40, and 60-watt lamps, $30. A new domestic service schedule, starting at 11 cents a kilowatt-hour, has also been accepted.

Western States Gas & Electric's El Dorado Development.—The Western States Gas & Electric Company, with headquarters in Stockton, Cal., has been authorized by the California Railroad Commission to issue and sell at not less than 88½ per cent of face value, plus accrued interest, $800,000 of its first and unified mortgage series "A" gold bonds, due March 1, 1947, for the purpose of financing in part the cost of completing the first unit of its El Dorado power development project. The El Dorado project will develop 28,000 hp. and is scheduled for completion early in 1924.

Georgia Company Adds Eight Towns to Distribution System.—The retail distribution systems of the Wofford Shoals Light & Power Company in Cornelia, Clarkesville, Alto, Baldwin, Lula, Mount Airy, Bellton and Hollingsworth have been purchased by the Georgia Railway & Power Company, which will take over the property on Jan. 1 and will operate it thereafter as an integral part of its system. The towns involved are on or near the main line of the Southern Railway and approximately 80 miles from Atlanta. With this acquisition the Georgia Railway & Power Company will operate the retail distribution systems in twenty-one towns besides serving forty on a wholesale basis.

Growth of Public Service Corporation of New Jersey.—The Public Service Corporation of New Jersey, which has rounded out its twentieth year, now serves a population which, according to a historical and statistical booklet just issued by the company, has grown from 1,631,174 to 2,829,604. It supplies 228 municipalities as compared with 115 when it was incorporated. The annual revenues of its electric department have increased more than $26,000,000 and the individual demand for service from 32 kw.-hr. to 203 kw.-hr. a year (in 1920) per inhabitant. The company's annual tax bill rose to $8,235,736 in 1922. Its kilowatt-hour sales for the current year will reach more than a billion, its experts estimate.

Southern California Edison Company Orders Large Synchronous Condensers.—The Southern California Edison Company has ordered from the Westinghouse Electric & Manufacturing Company three 30,000-kva. synchronous condensers with direct-connected exciters and nine 11,667-kva. step-down transformers with starting taps for the synchronous condensers. The condensers have a maximum capacity of 35,000 kva. and are, the manufacturer says, the largest in the United States.

Opposition to Diversion of San Benito River.—The Federal Power Commission will probably reject the application of W. Neumann and D. Hirstel of San Francisco for a preliminary permit covering a projected diversion of the San Benito River from its natural course into the San Joaquin River. Investigation has revealed that all of the water of the San Benito is needed for irrigating lands along its natural course. Moreover, it is believed that the development of the river in its natural course is more promising and less expensive than the proposed diversion, which would almost certainly result in extensive litigation.

Engineers Oppose City Distribution of Hetch Hetchy Power.—That acquisition by the city of San Francisco of a municipal distribution system at the present time would cripple the water project financially and endanger the city's rights to the use of the water was the gist of a report adopted by the American Association of Engineers at a meeting held in San Francisco recently. Temporary distribution of power through existing agencies was recommended. The report says that 76 per cent of the power used in the Bay region is used by manufacturing and commercial interests which are more interested in reliability of service than in the possibility of slightly lower rates.

Public Ownership Agitation in Washington State.—The Washington Superpower League, organized in Seattle for the purpose of supporting the passage of legislation to permit cities to sell power outside their boundaries, will support an initiative power bill to be submitted to the voters at the 1924 election providing for public ownership of utilities, particularly power plants, and will take into consideration the Erickson and Bone bills, both permitting cities to sell power outside their boundaries. Whether the Washington Superpower League will co-operate with the Seattle Municipal League is uncertain, there being said to be a difference in plans.

One Circuit of Cincinnati-Dayton Line Finished.—One of the two 66,000-volt circuits under construction from Dayton to Cincinnati has been placed in service. This circuit consists of 27 miles of wooden poles and 2 miles of steel towers. Thirty-three consecutive days comprised the total working time

of the wire-stringing gang. A temporary substation at Miller's Ford consists of three single-phase, 8,333-kw. water-cooled transformers. These transformers require 1,925 gal. of oil and weigh 46,400 lb. They have a temperature rating not to exceed 55 deg. C. at a continuous load with circulating water of 27 gal. per minute. The efficiency at full-load rating is 99.05 per cent. Oxide-film arresters totaling 536 cells provide lightning-arrester protection. Three of the legs carry weatherproof spark gaps, which are mounted on top of the stack assembly. Work is rapidly continuing on the second line, which is very nearly completed.

French to Open Wire Service for Drawings and Manuscripts.—Beginning Jan. 1, press dispatches say, drawings, plans, designs and manuscripts will be accepted by the French government telegraph administration and transmitted by wire. These will be called telautographic messages. Their commercial possibility is due to Edouard Belin, an inventor. At the beginning messages will be accepted for transmission only between Paris and Lyons and Paris and Strasbourg. Later the system will be extended to connect all the big centers of France. By the Belin method so exact a reproduction of the original is obtained at the receiving station that transmitted signatures will be valid. The cost of transmission is relatively small, being 10 francs or 20 francs, according to the dimensions of the manuscript or drawing.

California Co-operative Campaign Plans 1924 Work.—The plans of the California Electrical Co-operative Campaign for next year's activities, as announced at the meeting of the executive committee at Del Monte, Dec. 7, were a continuation of the portable window-lighting exhibit, the electrical homes, the work with the architects and builders and the assistance being given contractors and dealers in merchandising methods, window trimming and store arrangement. The portable window-lighting exhibit mounted on a Ford truck has been shown in forty cities and towns of the state during the year with very tangible results in new business obtained. Seven electrical homes have been shown in the last year, with an average attendance of between fifteen and twenty thousand persons per home. An appropriation equal to that of last year is being sought to carry on the work, and indications are that there will be no difficulty in obtaining this.

Utah Company Providing Against Emergencies.—The Jordan River in Utah, which was withdrawn from entry a few years ago, with other main tributaries of the Great Salt Lake, because of the investigation of a reclamation project, has been restored to entry, and the Utah Power & Light Company has filed an application for the use of 75 second-feet of water in its Jordan steam-plant extensions. The power company wishes to supplement its hydro-electric system by enough steam capacity to make Salt Lake City and tributary territory assured of a continuous power supply in event of damage to transmission lines from the north. An order has been placed for a 20,000-kw. steam turbine, which will increase the company's installed capacity at the Jordan River plant to about 45,000 hp. Work has been under way for some time on the enlargement of the plant, and it is expected that the total expenditure will be about $1,500,000.

Ohio Power Company May Build High-Tension Line from South Bend to Lima.—That a 132,000-volt transmission line will be built by the Ohio Power Company through Fort Wayne, Ind., to connect South Bend with Lima, Ohio, provided the present plans of the company mature, became known when a photographer left Fort Wayne in an airplane to make pictures of the topography of the proposed route. Since work on the new power plant at Mishawaka, near South Bend, has started, S. W. Greenland, president and general manager of the Indiana Service Corporation, Fort Wayne, told a correspondent of the ELECTRICAL WORLD he had no doubt the proposed transmission line will be built and that if it is built the Indiana Service Corporation will take supplementary power from this source.

Associations and Societies

Worcester Section, A. I. E. E.—William C. Yates, manager of the industrial control sales department of the General Electric Company, Schenectady, N. Y., addressed this section last week on "Industrial Control and Applications."

Western Association of Electrical Inspectors.—The nineteenth annual meeting of this association will take place at the Hotel Fontenelle, Omaha, Neb., on Jan. 29-31, 1924. The meeting will in large part be devoted to the consideration and interpretation of the 1923 edition of the National Electrical Code. All inspectors in the United States and Canada are invited.

Next Year's Advertising Association Convention.—Lou E. Holland of Kansas City, president of the Associated Advertising Clubs of the World, with which the Public Utilities Advertising Association is amalgamated, has announced that July 14 has been definitely set as the date for the opening of the world convention of advertising in London next summer, and that plans are afoot to take over a delegation of at least two thousand publishers and advertisers from America.

Nebraska Section, N. E. L. A.—Horace M. Davis, secretary of this section, announces that the date of its 1924 convention, to be held at Omaha, will be May 8 and May 9.

Pennsylvania Electric Association.—On Jan. 16 a geographic section meeting of the Pennsylvania Electric Association will be held at the Hotel Adelphia in Philadelphia. There will be an all-day session. Power-station auxiliaries, interconnection and inductive coordination will be the topics.

Engineers' Club of Philadelphia.—A conference on economy in the use of fuel will be held by this club on Jan. 15, with morning, afternoon and evening sessions. The treatment of the subject is to be confined strictly to its engineering and financial phases, avoiding the commercial phase of competitive fuel-saving devices, and the program will be arranged approximately on the uses of fuel in the order of relative tonnage of possible fuel saving. Papers will be presented by engineers recognized as authorities in the various phases of the subject, with open discussion.

Technical National Section, N. E. L. A.—Group meetings of this section will be held in Birmingham, Ala., from Jan. 28 to Feb. 1 inclusive. A general meeting of the section is scheduled for Jan. 30 at 8.30 p.m. and a meeting of the executive committee for Jan. 31 at 6 p.m. Committee meetings convene at 9.30 a.m. as follows: Jan. 28, meter; Jan. 28-29, inductive co-ordination, underground systems; Jan. 29-30, electrical apparatus, prime movers, hydraulic power, meter, uniform specifications; Jan. 31, overhead systems, electrical apparatus, prime movers, hydraulic power, accident prevention, uniform specifications; Feb. 1, overhead systems, electrical apparatus, prime movers, accident prevention. Visits to the plants of the Alabama Power Company will be made.

Coming Meetings of Electrical and Other Technical Societies

[A complete directory of electrical associations is published in the first issue of each volume. See July 7 issue, page 56, for latest list.]

American Engineering Council (F. A. E. S.)—Washington, Jan. 10-11. L. W. Wallace, 26 Jackson Place, Washington.

Kentucky Association of Public Utilities—Seelbach Hotel, Louisville, Jan. 10-11. E. F. Kelly, Louisville Railway Company.

Wisconsin State Association of Electrical Contractors and Dealers—Pfister Hotel, Milwaukee, Jan. 17-19. H. M. Northrup, 23 Erie Street, Milwaukee.

National Association of Lighting Equipment Dealers — Hotel Sherman, Chicago, Jan. 21-26.

Technical National Section, N. E. L. A.—Birmingham, Jan. 28-Feb. 1.

Western Association of Electrical Inspectors—Hotel Fontenelle, Omaha, Jan. 29-31. W. S. Boyd, 175 West Jackson Blvd., Chicago.

American Institute of Electrical Engineers—Midwinter convention, Bellevue-Stratford Hotel, Philadelphia, Feb. 4-8. F. L. Hutchinson, 33 West 39th St., New York.

American Physical Society — New York, Feb. 23.

Commercial National Section, N. E. L. A.—St. Louis, Feb. 27-28.

Commission Rulings

Evidence of Going Value.—The North Dakota Board of Railroad Commissioners, valuing the property of the Red River Power Company, said that a statement purporting to show the gradual development of the business and the necessary expenditures and forbearance of financial return on the original investment of a utility company is not conclusive evidence of going value where it covers a period of years before commission regulation began and no attempt has been made to determine the reasonableness of the operating expenses for the early years.

Combining Meter Readings Prohibited—Rates to Large Consumers.—In ordering a reduction in the rates of the electric department of the Red River Power Company, the North Dakota Board of Railroad Commissioners condemned the practice of combining the readings of several meters in different locations owned by the same customer in order to reach a total large enough to be entitled to a reduced schedule. Such a practice the commission called unreasonable and discriminatory. On the question of reductions to large consumers it said that a lower rate is justified provided it is sufficiently remunerative to pay the output cost and a part of the fixed cost, but that any special rates which provide for the furnishing of service at less than production cost are unreasonable and discriminatory.

Essential Railroad Construction May Be Included in Rate Base.—In the course of the hearings held by the California Railroad Commission to arrive at a valuation for the Southern California Edison Company objection was raised to the company's total book investment in the San Joaquin & Eastern Railroad being included in the rate base. Representatives of certain consumers contended that the investment in the railroad should be entirely excluded from the rate base for the reason that it is incorporated and operated as a separate unit, that its rates are subject to orders of bodies other than the commission, and that it is engaged in the handling of express matter, excursion trains and passengers, which is an entirely different business from serving electrical energy. The commission, however, pointed out that the railroad was constructed in connection with the installation of the Big Creek power plants, that the bonds were guaranteed by the power company and all of the stock owned by it, that it was incorporated separately and has been operated as a common carrier under the jurisdiction of the Interstate Commerce Commission, that the evidence showed it to be necessary for the construction and operation of these plants, and that it is required for the construction and operation of new plants under way and for plants proposed for the future, and cannot be economically replaced by any other method of transportation. "The railroad therefore," said the commission," appears to be rendering a definite and necessary service in the construction and operation of hydro-electric plants, and for that reason the total investment cannot fairly be deducted from the rate base. The reasonableness of including the railroad investment in the rate base can be shown by considering the conditions if the road had only been useful during the construction period and thereafter removed. The expenditure would have been charged to construction of hydro-electric plants and the cost would have been prorated among the plants installed and would have become in that way a part of the rate base. The objection that the railroad is used in other business than electric does not prohibit it from being included in the electric rate base as these activities are incidental to the electric requirements and the revenues from these sources held pay expenses that would otherwise fall upon the electric consumer were it not operated as a common carrier. Necessarily credit to the electric business should be made for any earnings received from the railroad."

Invasion of Territory and "Gentlemen's Agreements."—In hearing a complaint brought by the Fleetwood & Kutztown Electric Light, Heat & Power Company against the Topton Electric Light & Power Company involving invasion of territory the Pennsylvania Public Service Commission refused to entertain a contention by the owners of the invading company that they were innocent purchasers for value of its stock without notice of an alleged understanding and "gentleman's agreement" not to enter certain territory. The commission held that the operations of the other company at the time of the stock purchase were sufficient to put the stockholders on notice and that upon proper inquiry full knowledge of facts could have been obtained.

Service Must Not Be Discontinued Where Bona Fide Dispute Exist.—Where a bona fide dispute exists between a utility company and a consumer in regard to a bill for service, payment cannot be enforced by shutting off service, according to a reiterated decision of the New Jersey Board of Public Utility Commissioners made in a complaint against a water company (Graves vs. Noteboom). The board said: "This matter has been passed upon formally by this board in the case of Murphy vs. Coast Gas Company. In its conclusions in that case the board said: 'Where gas companies do not require a deposit, the reasonably prompt payment of admittedly due bills for gas may be enforced by a prompt cessation of service. But the payment of back bills bona fide in dispute . . . cannot be enforced by shutting off service. The company still has a remedy in the courts.'"

Recent Court Decisions

Burden of Proof on Utility Company.—Dismissing a bill in equity brought by the Reno Power, Light & Water Company, alleging that rates fixed by the Nevada Public Service Commission for gas were confiscatory, the United States District Court declared that the burden is clearly on a utility company attacking rates fixed by a commission to show that, if enforced, the difference between the gross revenue derived from rates and the necessary ordinary expense of operation is too small to yield a fair return on the reasonable value of its property after paying taxes and a proper depreciation annuity. Reproduction cost, while a highly important fact in valuation, is not necessarily a controlling factor in fixing rates. The reasonable value of public utility property, declared the court, should be gathered from a careful and comprehensive consideration and comparison of its original cost, the cost of reproduction new, depreciation, additions, improvements, present and probable future revenues and expenses, market value of stocks and bonds, and any factor or circumstance which adds to or takes from its value.

Sweeping Limitation Imposed on Powers of Wisconsin Railroad Commission.—The Wisconsin Supreme Court has affrmed the decision handed down recently by the lower court at Madison in State vs. Washburn Waterworks Company, involving the issue of municipal or commission jurisdiction over public utility extensions within municipal boundaries. The Supreme Court in this important finding holds that authority to demand such extensions and to impose fines for failure to construct them is vested in the municipalities and not in the Wisconsin Railroad Commission. This is the case in which the commission had assessed fines against the waterworks company aggregating nearly a million dollars for failure to comply with the commission's order to make extensions requested by city officials and property owners. In a previous decision in the same case the Supreme Court, in the absence of any representative of the water company when the case was called, sustained the original decision of the commission and held the company liable in the amount of the accumulated fines. (See ELECTRICAL WORLD, Nov. 24, page 1087.) This order, however, was later rescinded on proof that officials of the company had not been apprised of the date of the hearing, and the case was restored to the calendar.

Men of the Industry

Changes in Personnel
Accomplishments, Responsibilities, Honors, Appointments and Activities of Men Engaged in all Branches of the Electrical Industry

John L. Livers Leaves Charlottesville

John L. Livers, president of the Charlottesville & Albemarle Railway Company and vice-president of the Virginia-Western Power Company, with which the street car and light properties were recently merged, has resigned. Mr. Livers has been connected with the electrical properties at Charlottesville since 1912, and under his management the company has successfully met the requirements for light, power and railway service of the city. He is a native of Gettysburg, Pa., and started his career in the electrical industry as lineman at the age of eighteen. For several years he engaged in construction work and subsequently entered the operating and contracting field. Mr. Livers' resignation, effective Dec. 31, will cause general regret in Charlottesville, where not only the electrical utilities have had the benefit of his valuable services but also every movement that made for civic betterment and progress. Early in January he will leave for Ormond Beach, Fla., where he will spend the winter.

W. H. Young, formerly connected with the operating department (electric) of the Central Hudson Gas & Electric Company, has been transferred to the engineering department of the company.

Andrew G. Betts, who has been connected with the meter department of the Tacoma (Wash.) Railway & Power Company for twelve years, has been appointed superintendent of the Olympia (Wash.) Light & Power Company.

Joseph Gartenman, formerly connected with Dwight P. Robinson, Inc., New York, as electrical designer, has joined the division of construction and engineering of Stone & Webster, Inc., in the capacity of electrical designing engineer.

Philip H. Chase of the Philadelphia Electric Company has been elected chairman of the Technical Section of the Pennsylvania Electric Association. E. C. Stone of the Duquesne Light Company was the chairman during the past year.

W. M. Walsh, for the past twelve years connected with the Adirondack Power & Light Corporation, Schenectady, N. Y., will join the organization of the Connecticut Light & Power Company at the general offices of the company in Waterbury, Conn., on Jan. 1. Mr. Walsh will be general merchandising manager in charge of the company's merchandising activities in Waterbury, Naugatuck, New Britain, Norwalk, Branford and Greenwich. He started with the Adirondack company twelve years ago as clerk and advanced rapidly, to the position of assistant sales manager in 1917 and sales manager in 1919.

Emile Garcke, British Electrical Engineer

Emile Garcke, president of the British Electrical Federation, London, has been associated with the electrical industry since 1883, and during that period of forty years he has devoted much time and energy to the development and progress of electrical enterprises. Mr. Garcke was born in Germany in 1856, but became a naturalized British subject in 1880. He became identified in 1883 with the management of the Brush Electrical Engineering Company, where he spent ten years in active service, and in 1910 he was made its chairman. From 1893 to 1895 he played the rôle of managing director of the Electric Construction Company for the purpose of reorganizing the company, and since that time as managing director of the British Electric Traction Company (and since 1911 as chairman) he has given special attention to promoting the electrification of the railroads in the United Kingdom.

EMILE GARCKE

Mr. Garcke was an original director of the Electric & General Investment Company and of the Electrical & Industrial Investment Company and is at the present time president of the British Electrical Federation. He is a member of the Institution of Electrical Engineers and has served as vice-president of the Tramways & Light Railways Association and as chairman of the electrical section of the London Chamber of Commerce. Mr. Garcke has contributed to the technical press and is the compiler of the "Manual of Electrical Undertakings," published annually.

R. F. Mullin, commercial manager in the Muncie division of the Indiana General Service Company, has been transferred to Elwood as division manager, succeeding Homer E. Gant, who has been made district manager of the North Western Ohio Light Company at Van Wert, Ohio.

Frank B. Jewett, vice-president of the Western Electric Company and past-president of the American Institute of Electrical Engineers, received the decoration of the fourth class of the Imperial Order of the Rising Sun on Monday, Dec. 24, at his office in New York City, by order of the Emperor of Japan. The honor was given in recognition of the assistance which Dr. Jewett and his company are giving to the Japanese government.

Edwin S. Webster, president of Stone & Webster, Inc., Boston, has been appointed honorary Japanese consul at Boston. The appointment was made to promote good will between Japan and the United States. Mr. Webster visited the Far East last year in the interest of hydro-electric and other proposed engineering developments, and he was a member of the citizens' committee in the recent Red Cross drive for Japanese earthquake relief.

Homer E. Gant of the Indiana General Service Company of Elwood, Ind., has been transferred to the North Western Ohio Light Company in the capacity of district manager, with headquarters at Van Wert, Ohio. Both these properties are subsidiaries of the American Gas & Electric Company. Mr. Gant was associated with the Indiana General Service Company at Marion for eighteen years and has been manager of the Elwood division for the past year.

Obituary

John Mustard, who had been associated with the electrical industry almost from its inception, died on Dec. 12 at his home in Philadelphia, at the age of fifty-six. From 1884 to 1887 Mr. Mustard was associated with the Marr Construction Company, Pittsburgh, being a pioneer in the installation of electric light plants. The following year he formed the contracting firm of Kingsbury & Mustard, Baltimore, and in 1891 he joined the Wagner Electric Manufacturing Company, St. Louis, as its Philadelphia representative. This position he held without interruption until the time of his death. For the past ten years Mr. Mustard was an active member of the exhibitors committee of the National Electric Light Association.

Manufacturing and Markets

Devoted to the Discussion of Business and Economic Problems of the Producer and Distributor, with Market Reports, Trade Activities, Foreign and Construction News

Modern Business Tendencies*

Keen Competition Makes Long-Term Commitments Dangerous—Strong Cash Position Determines Safety of Narrow Margins—A New Level of Commodity Prices

By Enoch B. Seitz
Executive Secretary American Washing Machine Manufacturers' Association, Chicago

THE keen competition for the American purchaser's dollar has brought about the conditions that characterize American business today. Striving to get the same dollar has brought about the greatest merchandising cost that has ever existed in America. This cost has been increased because merchandising has been attended with a greater advertising cost which is chargeable to sales expenses. The result is that business has been done at a smaller profit than has been the case in America for several decades. This small margin of profit which has crept into the conduct of business began about a year ago at a time when labor costs and commodity prices began to mount. Economists warned business concerning it ten months ago, and it has become a matter of greatest concern in the conduct of business today. The manufacturer realizes it, and possibly the jobber and dealer appreciate it, but it is doubtful whether the American public has any conception of the narrowness of the margin upon which business is done.

Term Merchandising

Keen competition has brought about the increasing tendency to merchandise upon terms. When there is the slightest buyers' resistance caused by the prevailing excuse that prices are too high, there is a tendency to offset those prices by inducements which are called "terms"—a small payment down and payments forever and a day. American business today is well characterized by the term "merchandising." If continued, this is going to have a most serious effect upon the balance sheets of many stable institutions, because the ordinary dealer is not thoroughly educated to what the use of the deferred plan in merchandising involves.

The average retailer selling on the deferred-payment plan must have, in addition to his working capital, a considerable sum of money to take care of delinquencies. It does not take very long for a modestly capitalized dealer, working on a small margin, to find himself in a stringent financial condition because he has neither capital nor credit to obtain the added amount of working funds that it takes to sell upon deferred payments. This is not said to deprecate legitimately deferred payments, particularly in the sale of electrical appliances. It is inconceivable what the industry would be today if it were not for the deferred-payment plan. Fully 85 per cent of the electric washers sold in the United States are sold on that plan. But there is a limit to the smallness of the cash payment. The length to which the paper should run, the minimum "down" payment and the maximum length of time given should be within sane and bankable limitations.

The smallness of profit that exists in present-day merchandising, after all, brings about a struggle for the survival of the fittest. There are a great many firms which are now pressing their business beyond the point where the increased sales are obtained at an increased cost per unit in selling and at such an additional expense that the narrow margin of profit is entirely wiped out. There are those who are "sitting tight and playing close" until this period of narrow margins is over. When this period ends, when labor and commodity prices again come down so that the narrowness of margin can again be increased, the companies remaining will not be those that have done the greatest amount of business during the preceding year, but those that have given the greater attention to their cash position during these months.

Too much emphasis cannot be placed on what a sound cash position means in present-day business. It involves the avoidance of placing one additional dollar in assets that will not permit rapid liquidation. It involves the turnover of inventories within the shortest possible time. It means keeping away from long-time commitments. One element that contributes much to the stability of the washing-machine industry is that since last March the average length of commitments has been reduced from ninety-seven days to eighty-two days. Those fifteen days saved mean that inventories are being turned over more often.

Cash Discounts

Again, a strong cash position at this time means the ability to take cash discounts. A business that does not take the regular 2 per cent within ten days for cash is neglecting a wonderful opportunity for earning. The business that passes up the rather liberal 5 per cent follows a policy that is nothing short of criminal. A strong cash position embodies the setting up of a reserve to provide for future contingencies. The businesses that sailed best through the slump of 1920 were those that had set aside funds of appreciation, realizing that the added profit of the fat years would be offset by the losses of the lean years. When the deflation came they had the appreciation fund with which to meet it; it had not been dissipated by declaring dividends. It was in liquid form to be used as a buffer against the shock that had to come. So the strong cash position of today is one that takes cognizance of the supreme necessity of building up a very liquid reserve.

*Presented before the twenty-eighth annual convention of the Central Division, N. E. C. A., Chicago, Nov. 21, 1923.

The uppermost question today in the minds of American business executives is, "Are we again facing some kind of a depression?" Commodity prices are still at a very high level as compared with 1913. If business is going to continue comparing present levels with those of another year, say 1913, there will always be the feeling that a deflation is due. But it is not unlike another period. In 1890 American business men were continually saying, "Oh, if we could just get back to normal, if we could just get back to the level of 1879, everything would then be fine."

They kept on talking about getting back to the good old days of eleven years before when levels stayed "put," but they never *did* get back to that level. And yet there came in time the most prosperous quarter of a century in history. Again, ten years after 1913, there are those who are continually yearning for the return to the price level of 1913. It is doubtful whether business will ever come down to it! Labor prices reached their peak last April and have declined slightly since—lowering only when and where non-employment increased. Some decline in commodity prices is due during the first half of 1924. With these natural downward tendencies in labor and commodity prices bringing them closer to agricultural prices, a new level should be established which should again be "normalcy."

Another very apparent tendency in business today is the evolution of an improved method of distribution. Distribution costs are too high. They have more than kept pace with the mounting cost of production. This is a recognized fact in almost all lines of business. Business can be had, but at a cost of getting that is greater than ever experienced before. Heroic efforts are being made to find new channels of distribution, to revamp old ones, to cut corners, to do something that will lighten the load of distribution costs.

Out of this endeavor must come one of two things—either there must be an appreciation on the part of the buying public that the purchase price of an article includes justifiable charges for services performed in bringing that article from the place of fabrication to the consumer's home, or there must be a shortening of the route—moving merchandise much more directly.

With all of the great merchandising brains of our country busy on this problem a solution will be forthcoming. The philosopher of New England wrote many years ago that he who does things better than another will have a path beaten to his door; but he who can bring out of the costly tangle and expensive maze of modern business an orderly, usable, efficient and economic method of distribution will have countless thousands of American business executives arising to call him blessed.

The Market Situation in Coal

An Abstract of a Statement Recently Presented Before the Association of Edison Illuminating Companies that Has a Distinct Interest for Electrical Manufacturers

BY EUGENE MCAULIFFE
President Union Pacific Coal Company

FOR some years the coal industry has, because of its irregularities, caused all consumers, all business, much embarrassment and expense. It has added heavily to the burden of a sorely taxed transportation machine, and it is quite safe to say that it has caused manufacturers and the managers and executives of the great public utility companies more sleepless hours than all other domestic disturbances combined. Gradually this condition has grown to be looked upon as definitely unbearable.

Today the industry is managed by operators divided between two schools of medicine. The one school administers the properties in its charge as directed by a definitely militant labor organization, an organization which has its genesis in the abuses inflicted on mine labor a generation ago, abuses which still rankle in the minds of the older men, and which again make good material for the thunder of the paid leaders. The other school comprises the so-called open-shop or non-union operators, who write their own prescriptions, which in late years have been made palatable by better housing, sanitation, amusement and educational facilities.

EXCESS MINE COST

The result is that the excess mine cost, the excess tax put on transportation, the deflection in quality and other less material losses have added to the nation's fuel bill at least $1 per ton in the form of direct expense, and when the waste of man power is computed a further great indirect loss, but one difficult of measurement, has been suffered by the nation. To the public utilities, on whom a demand for service is made which cannot be flouted, the loss has fallen ton for ton the heaviest, and upon the steam transportation service of the nation immeasurable losses have been inflicted. The recent anthracite wage settlement, which is beginning rapidly to be looked upon as the result of political expediency, does not promise much in the way of example to be followed when the union bituminous wage scale covering mines north of the Ohio River expires March 31 next. It is, therefore, on the reaction of the public to the Coal Commission's recent report that we shall have to depend for betterment. I will attempt to suggest the changes that may happen to the industry between 1923 and 1930.

WHAT MUST BE DONE

The coal strike must go as a method of settling industrial disputes within industries basic and fundamental, such as the coal industry. The operator and the mine worker must take on a new "attitude of mind." The rights of the man who pays the bills must be brought definitely to the front. To accomplish this few changes need be made in the existing order of affairs. These, however, must be well-foundationed changes and they must include:

(a) There must be fullest publicity regarding every affair of the industry and the labor employed therein, its costs, profits or losses, the rate of wages paid, the opportunity for employment afforded the worker, and the extent to which the worker avails himself of the opportunity. Employers who tenaciously opposed the theory of reporting facts during the periods of high earnings now for the second time express a willingness to submit facts. The facts referred to must be collected by the federal government and by men who can and will place correct and fearless interpretation on them. This department, wholly educational, will give expression to the most valuable function of government, the informative.

(b) The wasteful expenditure of new capital, coal reserves and man power which is still taking place must be checked by governmental regulation, which can be of a simple, direct char-

acter that will effect correction without destruction of property rights.

(c) The status of the mine worker must be defined, not through any system of certification such as now exists in certain states and which gives the union the power to dispense to the individual the right to seek employment, but by the full and prompt publication of the facts covering earnings and living conditions, thereby automatically putting the force of public opinion behind such corrective measures as are necessary to bring the slacker up to his proper place in the march of progress.

(d) Recognition must come of the principle that any labor-saving machine which is capable of transmuting the toiler into a machine operator or semi-skilled mechanic represents human betterment and should not alone be encouraged but enforced.

(e) There must be such revision of the present "master and man" relationship as will create mutual confidence and respect between the operator and the mine worker, and this will come when there is full publicity of governing conditions. The present attitude of militant belligerency is due very largely to the lack of knowledge concerning the facts under which the present uncertain relation is maintained.

The changes set forth above will take place between now and 1930, and the result will be a stabilized industry, with a livable load factor—an industry whose capacity expressed in mines and man power will fit better the load it must bear.

Material reductions in wages will not be made. I am prepared to say that, with publicity and the advent of mechanical loading machines and perhaps a conveyor form of haulage, largely displacing the many small cars now used underground, an even higher unit wage will be paid in certain districts, a combination of day wage and bonus paid on a tonnage basis perhaps best fitting the new mechanical order. The item of personal safety, now much disregarded, with its resultant social losses, will receive growing attention, but with added expense to the producer, a situation with which we will not quarrel.

The net gain flowing from increased efficiency will tend to effect reductions in cost of production, however, and as an offset definite weight must be given to the rapid exhaustion, largely through waste, of our more accessible and readily removable coal acreage, a situation of which the American people are sadly ignorant. Too many statements regarding the billions of tons of coal in reserve have been fed to the public, these statements being seldom qualified by the facts relating to remoteness from industrial centers and areas of dense population, to the quality of the coal, the thickness of the overburden and the seam itself, the angle at which it lies, and the possible absence of the certain other conditions which are necessary to removal, except at great expense.

The gradual exhaustion of the anthracite reserves, with the definite knowledge that the portion yet in reserve will cost more to remove and prepare than did that which has been mined, plus the recent increase in mining wages granted, will cause a tightening there, perhaps slow to evidence itself; and the profligate waste of our national oil reserves, now also taking place, is another factor that eventually will militate against cheaper fuel.

I can see little in the way of cheaper fuel from mines or oil fields. Doubtless, the maximum measure of relief that will be made possible will, as heretofore, take the path already blazed and followed—an extension of the present hydro-electric power resources and the greater efficiency to be obtained with the fuel used.

Business Conditions

A Survey of Important Developments in the Electrical Market Including Data on Production, the Sales Outlook, Credits, Exports, the Metals and Other Conditions Affecting Cost, Supply and Demand

THE electrical trade is closing out the year with a high degree of satisfaction. The tremendous volume of building construction has brought a large market for electrical material throughout the year. The Christmas season apparently has pretty generally exceeded expectations. The month of December goes out with stocks low and the promise of good business to follow the inventory-taking period.

New England continues this week the bright spot on the map. Mild weather there has permitted the work on central-station lines to continue. Appliance sales have been extremely heavy. Lamp and fixture business continues strong in the New York district with credit conditions very good. Prices are holding firm. In the Southwest wholesalers' and retailers' stocks are very low and lamp sales are running 25 per cent better than last year. In and around Chicago building continues, though work on the power lines has stopped. Manufacturers are sold out on cable. The market is generally firm.

There have been a number of reductions in price affecting pole-line hardware, flexible armored conductors and connectors in the East and lamp cord in the Middle West. Tape is expected to advance somewhat after Jan. 1. The Pacific Coast reports a strong business situation.

Wire Makers' Bookings Running to March—1924 Promises Well

RUBBER-COVERED and weatherproof wire manufacturers are running at top production as the year closes, and some of these report future orders as far ahead as May. Present production schedules are mostly filled until three months into the new year. It is the opinion of the leading wire manufacturers that an excellent year of buying by the industrials and central-station companies is in order and that placements are guided to those mills that can supply sufficient quantities in reasonable time.

During 1923 interconnection work and the building of new trunk lines between new generating plants and load centers have had a fair effect in orders for bare wire. In addition, a considerable amount of replacement business came from the electric railways.

Fluctuations in the copper market during the past two months have not been so often reflected in the wholesale market, owing to the practice of the manufacturers who are keeping large stocks of all sizes in the distributors' warehouses. Moreover, there is evidence in the market that manufacturers are shipping these stocks in larger quantities so as to reduce freight costs to a minimum. In turn raw materials are being bought in larger quantities to insure against shortages and the possibility of a rising market at the beginning of the year after inventories are taken. During last week wholesale prices on rubber-covered wire gained approximately 5 per cent in leading market centers of the East and Middle West.

Wooden-Pole Producers Anticipate Greater Sales in 1924

WITH wooden-pole purchases for this year actually completed, the producing companies are reviewing the events of the last twelve months in order to advance their production schedules as near as possible to the estimated purchase requirements of central-station and telephone systems for 1924. This year's business has been far above that obtained in 1922, and many of the wooden-pole producers are anticipating that the sales for their products will be equally good during the next twelve months. Accordingly it is known that certain of the larger interests are laying plans for big contracts in forest lands and labor.

The recent scarcity of certain sizes of wooden poles no longer exists because improved transportation and better cutting programs in the woods have offset the unusual demand for poles in the Middle Western and Eastern States. Orders during the last two months have been somewhat lower, however,

than during the summer months. A falling off of particular import has developed in the Southern States, where a great number of steel poles have been sold. Authorities in the field state that this reduction has been largely seasonal, and this statement is borne out by open knowledge in the industry that the market as a whole is very stable with no change in prices over a considerable period of time.

Another development in present business which will have much to do with an increase in 1924 sales is the matter of the rehabilitation of the devastated sections in Japan. Already this influence in the market is causing considerable buying up of the whole American lumber market. A conservative estimate of the number of feet of timber required for the rebuilding of Japan's transmission lines and houses will run between two billion and four billion feet. Pole producers are calculating how to obtain contracts for this Japanese business to the best advantage of both countries. It is thought that much timber of central-station size but which does not meet in all respects the standard specifications of the central stations of this country can be sold to Japanese buyers.

An element of growing importance in the market of the cedar-pole producers is the sale of the Southern yellow-pine poles. Whether the market will favor Southern yellow-pine poles in place of Western red cedar because of the difference in price levels and available stocks is yet to be seen, and it is a factor which is being closely watched by the pole-producing interests at this time. An important consideration is that Southern yellow pine takes less time to attain its full maturity than does Northern white cedar or Western red cedar. With pole prices about 30 per cent higher than they were in 1921, there are indications that prices may be shaded slightly during this period of the year to induce the central stations to do their purchasing now.

Building Material Selling Strong in Middle West—Lamp-Cord Price Revision

THE continued mild weather has helped the building program in the Middle West and the electrical trade is deriving more benefit from this business than in former years. Good purchases of most electrical construction commodities are in sight, being limited, however, or scheduled for delivery the first of the year.

The demand for pole-line hardware has fallen off this month, but this is perhaps merely a seasonal occurrence. Deliveries are being made promptly on all standard lines of hardware, while specialties are being turned out in good time. Prices remain firm. While there are no indications at present of higher prices, it is thought there will be no reductions in prices.

The cable situation is unchanged. Most manufacturers are sold up to capacity, and new business is not particularly welcome where immediate delivery is required. Single-conductor paper - cable deliveries run about twenty-eight to thirty weeks, while multiple-conductor deliveries run about fifty weeks.

The price of lamp cords was revised on Dec. 17. Single-conductor prices declined a trifle and twisted pair prices advanced. Pure silk lamp cord is apparently being closed out in this district, and another manufacturer has announced that as soon as present stocks are exhausted he will make silk only.

Switchboard accessories sales have been good this week. One manufacturer reports the placing of orders for a considerable quantity of this class of merchandise for delivery the first quarter of next year. Prices remain firm, with no increase anticipated. Stocks are apparently adequate, as deliveries are being made within a reasonable period.

Indications are that friction tape should advance after Jan. 1. During the last ninety days cotton has advanced from 22 cents a pound to 37 cents a pound. With one exception during 1920, this is the highest point reached in fifty-eight years. Cotton sheeting, an essential in the manufacture of all friction tape, has undergone a rapid advance; but, even so, it has not kept up with the advance in cotton. This means that sheeting should advance.

Line Material Selling Fast in New England

PROTRACTED open weather has led to unusually large sales of pole-line material for central-station service, and the movement of this class of supplies continued extremely active to the end of last week. Pole-line hardware eased off about 5 per cent in price and flexible armored conductor weakened about 5 per cent before the holidays. Other prices held fairly firm, but the usual retail reductions were anticipated for the post-Christmas trade and considerable deferred buying of radio apparatus was in sight at Boston when the Christmas closing occurred. Little complaint as to shortages was heard before Christmas among jobbers, although storage batteries of exceptionally high grade were reported scarce in some circles owing to the demand for radio service and a spurt of automobile battery-renewal buying resulting from the mild weather.

Every indication points to a superb electrical appliance business this year, many merchandisers running 40 per cent or more above 1922 totals. General business in New England shows uneven streaks in textiles with the usual pre-inventory losses of manufacturing production. Underlying conditions are sound, and in the electrical industry the demand is widespread that substantial tax reduction shall be accomplished at the present congressional session.

Conditions Quiet in the New York District—Outlook Optimistic

ELECTRICAL business in New York City for last week was without important change except for those lines which included the large volume of holiday purchasing. There was apparently no let-up in the demand for lamps, fixtures and the general line of heating and cleaning apparatus. Prices of connectors for Nos. 12 and 14 armored cable have been reduced from $29.50 to $27. This cut is said to have been made in order to gather in some of the important orders which are floating around the market after severe reductions by smaller interests during the last month.

Although most of the jobbers, industrials and dealers are now preparing for inventory taking, sales books show higher volumes than one year ago and better credit conditions are reported for the New York territory. According to the National Electrical Credit Association, the November situation showed an improvement of $30 in the average delinquent account. In November, 1922, 389 delinquent accounts, totaling $84,743 and averaging $218 apiece, were reported, in comparison with last month's total of 344, which were valued at $50,725 and averaged $145 a piece.

The electrical trade is keeping in general run, with prosperous conditions reported in commodities affected by the greater purchasing power of the industrials and central stations. An estimated gain of about 12 per cent in the value of the year's crops implies an increased buying power in the farming communities, while labor is still well employed at most manufacturing centers of New York State and New Jersey. More building construction is being done than is usual because of the warmer weather at this period. It is said that this month's purchases by the industrials and central stations have been close to the November rate, with railroads and automobile makers active in the market.

The firm undertone of prices in the electrical industry is being generally maintained. A more optimistic spirit prevails in the jobbing houses, and men in the field express optimism concerning January and February business.

Easier Market Ahead on the Coast —Collections Improving

THE electrical fraternity on the Pacific Coast is well pleased with the results of the year just closed and looks forward confidently to 1924. Except in isolated cases where low crop prices or unfavorable weather has cut the profits of the farmer and depressed local business, the electrical industry has run very close to the sales totals of the bumper year of 1920.

Building permits for Los Angeles will total nearly $190,000,000, as compared with $121,000,000 for last year; in San Francisco about $45,000,000, which is close to last year, and in Oakland nearly $28,000,000, as against

$24,500,000 for 1922. This activity has been directly reflected in the demand for wiring materials. Very favorable indications of easier markets are seen in the large and well-assorted stock orders which are now being received. Collections are steadily improving and are now averaging below fifty days.

Some very definite improvements are seen in background conditions in the industry. Better merchandising methods are distinctly in evidence. Accounting is on a far better basis among small electrical contractors and dealers. Meanwhile new industrial markets are being made in the Los Angeles and San Francisco Bay regions. Lack of employment is almost non-existent, and it is difficult to be other than highly optimistic. The only possible upset would apparently have to come through factors which are now indiscernible.

All Stocks Low in the Southeast with Excellent Business in Sight

A RECORD-BREAKING holiday trade is reported in the Southeast, the increase over last Christmas ranging from 20 to 35 per cent, and there will be little or no carry-over of Christmas specialties. While the seasonal lines are, of course, moving best, jobbers state that staple lines are holding up well and that inventory time will find stocks generally low in the territory. Retailers are jubilant over the business they have enjoyed, and as a result their stocks are also low.

Heating devices and radio equipment have gone like wildfire, and practically no stocks will be carried over to the first of the year. Lamp sales are at a peak and show an increase of approximately 25 per cent over last December. Retailers handling portables report a very substantial business on the more expensive types, and are more than satisfied over having been able to discard the cheaper type. The portable business as a whole is excellent, and this is very satisfying from the central-station point of view. All in all, 1923 has been a wonderful year in the electrical industry in the Southeast, and as conditions are improving steadily, the new year starts with enthusiasm and optimism.

November Delinquent Electrical Accounts Lower

FOUR of the five divisions reporting to the National Electrical Credit Association for November have lowered their number of accounts as compared with October, 1923. The other territory, New England, remains the same. However, the average amount for the Central, Philadelphia and New England divisions increased over October, 1923. For the Central Division territory the average account for October, 1923, listed $109.74, while in November it was $160.43.

Conditions in the New York territory are improving, since the average account for November, 1923, was $30 lower than in October. Although the accounts for November, 1923, in Philadelphia decreased, the average amount increased from $99.84 to $133.82. The total number of accounts for the Pacific Coast for November, 1923, were less by five than in October, and the average amount now stands at $236.25.

DELINQUENT ACCOUNTS IN NOVEMBER

Branch and Month	Number of Delinquent Accounts Reported	Total Amount	Average Amount
Central Division:			
Oct., 1922	872	$102,465.52	$117.50
Oct., 1923	981	117,653.05	109.74
Nov., 1922	813	141,482.10	174.02
Nov., 1923	912	146,308.04	160.43
New York:			
Oct., 1922	517	59,602.00	115.00
Oct., 1923	442	77,479.00	175.00
Nov., 1922	389	84,743.00	218.00
Nov., 1923	344	50,725.00	145.00
Philadelphia:			
Oct., 1922	262	24,609.19	93.93
Oct., 1923	326	32,537.98	99.84
Nov., 1922	215	24,703.46	114.90
Nov., 1923	222	29,708.60	133.82
New England:			
Oct., 1922	80	11,223.14	140.29
Oct., 1923	51	3,808.88	74.68
Nov., 1922	47	6,130.29	130.43
Nov., 1923	51	6,018.34	118.01
Pacific Coast:			
Oct., 1922	22	3,980.61	180.50
Oct., 1923	23	5,804.78	252.38
Nov., 1922	24	4,117.10	171.54
Nov., 1923	18	4,252.62	236.25

The Metal Market

COPPER eased off a trifle last week, when outsiders and two or three small producers offered the metal at 13 cents, delivered, to the Connecticut Valley. In fact, offers were as low as 12.95 cents, delivered. The lower offerings revealed a little anxiety to dispose of small tonnages, and it is probable that had large inquiries come along the sellers would have strengthened up to 13.75 cents, which is still the theoretical quotation of the large producers.

Business was fair in the aggregate, especially considering the season of the year, and there are no indications that the market will go below 13 cents. Producers are still well sold ahead from the heavy purchasing in November, and the influence of this on the market is still felt. Last week's threats of the disbanding of the copper export association by no means created a panic in prices, and they held well considering the situation.

The official contract price of lead, as quoted by the American Smelting & Refining Company, was increased from 7.25 cents to 7.40 cents, delivered, New York. The lead market is substantially unchanged from last week, except that even higher prices are being asked for nearby deliveries. One of the producers is quoting as high as 8.12½ cents, New York, although no sales have been reported at that figure. A fair tonnage of lead for late January and early February shipment was sold during the week. The slab zinc market is weaker in tone.

NEW YORK METAL MARKET PRICES

	Dec. 20, 1923 Cents per Pound	Dec. 27, 1923 Cents per Pound
Copper, electrolytic	13.50	13.00
Lead, Am. S. & R. price	7.00	7.40
Antimony	9.00	9.00
Nickel, ingot	27.00 to 30.00	27.00 to 30.00
Zinc, spot	6.35	6.35
Tin, Straits	45.00	46.00
Aluminum, 98 to 99 per cent	26.00 to 27.00	27.00

Activities of the Trade

Devoted to News of the Manufacturer, Jobber, Agent, Contractor and Dealer, Including Important Orders and Contracts for Apparatus and Equipment

New Factory in St. Louis for Electric Storage Battery

Work is well under way on the new building of the Electric Storage Battery Company at Vandeventer and Choteau Avenues, St. Louis. This is the third building that the company has occupied since a branch was opened in that city in 1907. At that time one floor, occupying approximately 1,000 sq.ft., was sufficient. Seven years later larger quarters were secured in Walnut Street, where the company had 15,000 sq.ft. available.

With the steady growth of business it became apparent that still larger quarters were necessary to enable the St. Louis branch to handle its business in an efficient manner, and hence the new building, with 32,000 sq.ft. of floor space. This building is on the Missouri-Pacific railroad line. In it will be housed the administration offices of the St. Louis branch, from which orders from Missouri, southern Illinois, Arkansas, Louisiana, Oklahoma and Texas will be cared for.

Wakefield Brass Official Gives Optimistic Viewpoint for 1924

A. F. Wakefield, vice-president of the Wakefield Brass Company, in a statement made last week said: "Owing to the popularity of the kitchen lighting idea and the fact that central stations are campaigning for this class of business, we feel that the first half of 1924 will be a busy season for our company. There is no indication to us that 1924 will be a boom year, but it will be, we feel sure, a comfortably prosperous year.

"We have recently built additions to our factory and have added substantially to our equipment; likewise we have increased our sales and advertising programs to an optimistic but

reasonable extent. We expect to have to work hard for every dollar in 1924, but we also expect that a satisfactory number of dollars will accrue from our hard work."

P. A. Geier Will Double Space

"The fact that we have just started construction upon two new factory units which will approximately double our manufacturing space indicates that we look forward to 1924 with considerable optimism," said F. J. Gottron, general manager of P. A. Geier Company, Cleveland, manufacturer of domestic electric appliances, in a statement last week.

"We believe that operations in the coming year must be conducted upon a basis of strict economy and high efficiency, but these are ideals toward which sensible business men struggle in good times instead of waiting for hard times to enforce them. The coming year promises reasonable increases in both volume and net profits, and we have set our manufacturing and sales quotas accordingly."

Industrial Electric Heating Organization Changes Hands

The electric heating apparatus business of the Boston Last Company, Boston, which has been conducted for many years at 44 Biford Street, has been purchased by Donald Heath, Winthrop, Mass., and Charles Lowell and Harold L. Spooner, Whitman, Mass., and the new owners will soon begin business at Whitman under the firm name of the Boston Electric Heating Corporation.

Manufacturing space has been leased at the G. G. Roberts Corporation factory on South Avenue. As in the past, the company will specialize in electric heating equipment for manufacturing purposes. In the new organization Mr. Heath will have charge of production, Mr. Lowell of sales and Mr. Spooner of finances.

American Brass Company Joins Copper and Brass Association

At a meeting of the Copper & Brass Research Association held last week at the offices of the association, 25 Broadway, New York City, the American Brass Company was unanimously elected a member. The American Brass Company, which is affiliated with the Anaconda Copper Mining Company, is one of the largest fabricating and manufacturing units in the industry.

The association now numbers in its membership the leading copper and brass fabricating and distributing companies in the United States, representing approximately 80 per cent of the brass and copper facilities of the country. The producer members total twenty-five and represent the preponderance of the country's copper production.

Westinghouse Acquires New Building in Cleveland

The Cleveland branches of the Westinghouse Electric & Manufacturing Company and the Westinghouse Lamp Company have consolidated in one building their sales and service departments and their warehouses. The new five-story building, which is called the Westinghouse Electric Building, has 115 front feet on Ashland Road and is 130 ft. deep. The executive sales and clerical divisions have their offices on the top floor. Two floors are given over to the service department and two to warehousing facilities.

The building is in every way equipped for complete and efficient service to the electrical trade. In the service department the latest types of equipment are installed for repairing and rebuilding electrical apparatus of all kinds. In addition to a large stock of industrial equipment, supplies and merchandising items, a supply of renewal parts will be carried in the warehouses.

Adequate transportation facilities are available for the shipment and receipt of material. A private siding from the Pennsylvania Railroad has been provided for carload shipments. A platform that will accommodate three trucks at a time serves for the shipment of express and freight in less-than-carload lots.

Triumph Electric Holds Sales Convention in Cincinnati

Salesmen of the Triumph Electric Company, Cincinnati, have just returned to their various district headquarters after a two-day convention held at the home office. In order to finish the program for the convention in two days, various group meetings were held. The important features of the company's motors were discussed for the benefit of the new members of the sales force. This was followed by a trip through the factory, during which refinements and advanced mechanical features of the line for 1924 were explained and demonstrated.

The expanded facilities for manufacturing large-sized motors up to 200 hp. were also inspected, as well as the service department, which has been organized to insure the firm's customers prompt and efficient service during rush periods.

Columbus Jobbers Ship Appliances by Airplane

An aërial precedent was recently established in Columbus, Ohio, when the Hughes-Peters Electric Corporation delivered electrical merchandise a distance of 47 miles by airplane.

The Hughes-Peters firm, Columbus jobbers for the Westinghouse Electric & Manufacturing Company, received a rush order for electrical appliances from the Knecht-Feeney Electric Company, at Mount Vernon, Ohio, and immediately sent the order to a nearby flying field by truck. It was then loaded in a plane and carried to Mount Vernon, traveling the 47 miles in thirty-nine minutes. The trip would have required at least two hours had the goods been sent the entire distance by fast trucks.

Mine & Smelter Appointment

Announcement is made that Arthur E. Bacon has been appointed manager of the electrical department of the Mine & Smelter Supply Company, which does a jobbing business in Denver. Mr. Bacon was formerly with the Western Electric Company in the supply department and went to the Mine & Smelter firm as a salesman. On the recent resignation of James W. Ryall as the manager of the electrical department, Mr. Bacon was promoted to that position.

Mr. Bacon is a specialist in signal systems for mines and railroads.

The Uehling Instrument Company, Paterson, N. J., manufacturer of CO_2 recorders and other power-plant instruments, has recently appointed J. R. Williams, 2028 Jefferson County Bank Building, Birmingham, as its representative in Alabama. The Sheffield Company, Sheffield, Ala., has just purchased a representative installation of CO_2 recording and indicating equipment through Mr. Williams.

R. G. Chamberlain, district manager of the Hurley Machine Company, is in Spokane, Wash., co-operating in the campaign now being conducted by the Washington Water Power Company in the sale of Thor washing machines and of the new Hurley "Superior Oscillator." He says that general conditions are better than they have been for the past five years and on the basis of the results already obtained predicts success for the campaign, which is the largest ever organized by the Washington Water Power Company.

The Stewart Storage Battery Company, previously at Marshfield, Wis., has leased 10,000 sq.ft. of floor space on the third floor of the building at 361 West Superior Street, Chicago, where its manufacturing operations are now being conducted.

The American Brass Company, Kenosha, Wis., subsidiary of the Anaconda Copper Company, has placed the general contract for erecting a new copper wire mill, 220 ft x 540 ft., two stories of brick and concrete.

The General Electric Company, Philadelphia, will commence the construction of the second unit of its new plant on local property at Elmwood Avenue and Sixty-eighth Street, recently acquired. It will be one-story, 119 ft. x 254 ft., estimated to cost approximately $300,000, with equipment. The White Construction Company, New York, is the general contractor, and Harris & Richards, Drexel Building, Philadelphia, are architects.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

An agency is desired in Glasgow, Scotland (No. 8,678), for advertising signs and electrical tools and for electric heating and cooking equipment. Purchase and agency is also desired (No. 8,600) for electric advertising specialties for window display.

Purchase is desired in Port Said, Egypt (No. 8,603), for cooking utensils, flatirons, etc.

Purchase and agency is desired in Algiers, Algeria (No. 8,602), for electrical accessories, including heating, lighting, power, telephone and wireless apparatus; also (No. 8,601) for electrical supplies.

Purchase and agency is desired in London, England (No. 8,598), for electrical goods and for radio apparatus and parts.

An agency is desired in Oran, Algeria (No. 8,601), for electric lamps, radiators, irons and fixtures.

Purchase and agency is desired in Christchurch, New Zealand (No. 8,604), for small fractional-horsepower motors.

Purchase and agency is desired in Bienne, Switzerland (No. 8,667), for small motors for drilling, perforating, sharpening, etc.

Purchase is desired in Mexico City, Mexico (No. 8,608), for telephone equipment.

Purchase and agency is desired in Birmingham, England (No. 8,599), for tungsten or tungsten alloy.

An agency is desired in Auckland, New Zealand (No. 8,620), for radio apparatus and parts.

Purchase and agency is desired in Adelaide, Australia (No. 8,597), for radio apparatus and parts.

Purchase is desired in Johannesburg, South Africa (No. 8,609), for radio apparatus and parts.

An agency is desired in Vienna, Austria (No. 8,650), for machinery and apparatus for power plants, mines and the metallurgical industry.

PROPOSED TELEPHONE SYSTEM AT SMYRNA.—The Turkish government, *Commerce Reports* states, has given the officials at Smyrna permission to ask for bids for the installation of a telephone service.

New Apparatus and Publications

ELECTRIC SPECIALTIES.—Catalog No. 12 issued by the G. & W. Electric Company, 7440 South Chicago Avenue, Chicago, contains bulletin No. 231, covering its potheads and accessories, and bulletin No. 232, describing its underground boxes.

ELECTRIC WASHING MACHINES.—The Altorfer Brothers Company, Peoria, Ill., has issued a booklet entitled "How 437 Dealers Brought Customers to Their Stores," which describes its method of selling electric washing machines which has been tested by the "A B C" dealers throughout the United States.

AIR FILTERS.—The Midwest Air Filters, Inc., 100 East Forty-fifth Street, New York City, is distributing a folder calling attention to the use of the "Midwest Unit" air filters for power plants, factories, pneumatic tools, pneumatic water systems, ice-manufacturing plants, cleaning and drying spray paints, etc.

BASE ADAPTER.—The Ward Leonard Electric Company, Mount Vernon, N. Y., has developed a "Vitrohm" resistor unit with an "Edi-Swan" (bayonet lock) base.

RESISTANCE MATERIAL.—The Wireless Resistor Company of America, Milwaukee, is distributing a leaflet calling attention to its "Globar" resistance material (non-metallic, bar-shaped) for industrial and domestic heat.

RECORDING INSTRUMENT.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has developed a new portable recording instrument, known as type R.

FIRE-FIGHTING APPARATUS. — "The Essentials of Self-Protection Against Fire" is the title of a booklet published by the Foamite-Childs Corporation, Utica, N. Y., describing the various types of its fire-fighting devices.

ELECTRIC GRILL AND TOASTER.—An electric grill and toaster, consisting of two cooking pans and a toaster, has been placed on the market by the National Stamping & Electric Works, 3212 West Lake Street, Chicago.

PORTABLE LAMP.—A portable lamp of the pedestal type for use in garages, machine shops, etc., has been developed by the Universal Electric Bracket Company, 1,109 Pine Street, St. Louis, Mo.

New Incorporations

THE UNITED LIGHT & POWER COMPANY, 101 East Fayette Street, Baltimore, has been incorporated by George S. Newcomer, Douglas H. Rose and others.

THE KANAWHA VALLEY POWER COMPANY has been chartered with a capital stock of $100,000 by J. E. Harsh, W. D. Payne and others.

THE INTERSTATE POWER COMPANY, Kansas City, Kan., has been incorporated with a capital stock of $2,000 by W. D. Pratt, Fredonia; W. J. Breidenthal, R. J. Higgins, Stanley G. Stewart and O. P. Allee, all of Kansas City.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

FARMINGTON, ME. — The Franklin Light & Power Company has purchased all the power rights in the Carabasset stream at North Anson. The company plans to build a concrete dam and develop 3,000 hp.

BOSTON, MASS.—Bids, it is reported, are being asked by the Edison Electric Illuminating Company of Boston for an addition to the substation on Glenville Terminal, Allston, and for a substation at Dedham. Bigelow & Wadsworth, 120 Tremont Street, are architects.

BROCKTON, MASS.—Contract has been awarded to Stone & Webster, Inc., 147 Milk Street, Boston, by the Edison Electric Illuminating Company of Brockton for extensions at the East Bridgewater plant. The work will include two 588-hp. boilers, with oil-burning equipment for six boilers, a 10,000-bbl. oil-storage tank, concrete service tank, pumping equipment and heaters. The contract also includes the rearrangement of the present switching equipment, a 13,200-volt transmission line (4 miles long) to be erected from the station to Dupont Circle, where a switch house, transformer and switching equipment will be installed to tie the system into the transmission lines to be built to the Montaup Electric Company's plant at Fall River, Mass. The cost of the work is estimated at $785,000.

GARDINER, MASS. — Steps have been taken by the Chamber of Commerce for an improved lighting system in the business district.

HOPEDALE, R. I.—Plans are being prepared by John A. Stevens, Lowell, engineer, for a new power plant for the Draper Corporation.

WOONSOCKET, R. I.—The City Council has adopted a resolution authorizing the Blackstone Valley Gas & Electric Company to install forty-one lamps of 1,000 cp., twenty-two of 600 cp. and eighteen of 100 cp., on Blackstone, Arnold, Social and Clinton Streets.

Middle Atlantic States

ALBANY, N. Y.—The Rochester (N. Y.) Packing Company is planning to install an ice and refrigerating plant at its proposed new factory to be erected on Exchange Street, to cost about $500,000. Henschein & McLaren, 1637 Prairie Avenue, Chicago, are architects.

BATAVIA, N. Y.—The installation of an ornamental lighting system on Main and Jackson Streets, to cost about $15,000, is under consideration.

BROOKLYN, N. Y.—Plans for the ten-story warehouse to be erected by the St. Mark's Holding Corporation on the Eastern Parkway, to cost about $700,000, include elevating, conveying and other material-handling machinery. Charles B. Meyers, 31 Union Square, New York City, is architect.

BUFFALO, N. Y.—The Board of Education is considering the construction of a high and vocational school, to cost about $2,500,000. Associated Architects, 235 Delaware Avenue, are architects.

BUFFALO, N. Y.—The Niagara, Lockport & Ontario Power Company has applied to the Public Service Commission for permission to extend the development of water power on the Salmon River and for the right to condemn property along the stream regarded as necessary in connection with the project. The plans provide for the construction of six dams between the present power house and the village of Pulaski.

FISHKILL, N. Y.—The Wappingers Electric Light Company, Wappingers Falls, has applied to the Town Council for a franchise to supply electricity for lamps and motors in Fishkill.

HORNELL, N. Y.—The New York Central Electric Corporation has been authorized to issue $3,489,500 in capital stock, the proceeds to be used to acquire the following properties, including proposed extensions in plants and transmission lines: The Hornell (N. Y.) Electric Company; Wayne Power Company, Sodus; Yates Electric Light & Power Company, Penn Yan; Dansville (N. Y.) Gas & Electric Company; Perryville (N. Y.) Electric Light Company and the Warsaw (N. Y.) Gas & Electric Company.

SCHENECTADY, N. Y.—The City Council is considering an ordinance providing for a uniform system of lighting throughout the city.

TROY, N. Y.—Van Zandt, Inc., River and Rensselaer Streets, is planning to install a coal conveyor with elevating machinery at its power house.

VALATIE, N. Y.—Plans are being considered by the Centennial Paper Mills, Inc., for the installation of equipment in its power plant, including a 200-kw. generator, directly connected to steam turbine, with switchboard, etc.

YORKTOWN, N. Y.—Plans are under consideration by the Town Boards of Cortlandt and Yorktown for organizing a lighting district. The proposed district would also include the villages of Mohegan, Shrub Oak, Jefferson Valley and many outlying sections.

BRIDGETON, N. J.—The Electric Company of New Jersey plans to issue $107,000 in bonds and $445,200, in capital, part of the proceeds to be used for extensions in its system in Camden and Gloucester Counties.

DOVER, N. J.—Plans are being prepared by the New Jersey Power & Light Company for extensions to its system.

HAMMONTON, N. J.—The installation of two electrically driven pumps with auxiliary apparatus in the municipal waterworks is under consideration.

EAST GREENVILLE, PA.—The Pennsylvania Power & Light Company has taken over the property of the East Greenville Electric Light Company and will consolidate it with its system.

HARRISBURG, PA.—Appropriations are being arranged for extensions in the park lighting system and also for additional street lamps in the Market Street and Bellevue district.

NORRISTOWN, PA.—The Counties Gas & Electric Company proposes to increase the capacity of its 60,000-hp. steam-power plant now in course of construction at Barbadoes Island to 150,000 hp.

PITTSBURGH, PA.—The Duquesne Light Company is preparing plans for four substations, to be erected at Second, Third and Winthrop Avenues, Pittsburgh, and at Beaver Falls, respectively, to cost about $400,000.

WILLIAMSPORT, PA. — Electrically operated machinery will be installed in the proposed new factory, to cost about $150,000, of the Vallamont Planing Mill Company.

WILLIAMSTOWN, PA.—The East Penn Electric Company is perfecting plans to take over and consolidate the Lykens Valley Light & Power and the Washington

Township Electric Light, Heat & Power companies. Extensions will be made in transmission lines and a power generating plant built on the Juniata River, near Iroquois.

ABERDEEN, MD.—The Puritan Brick Company plans to construct a power house at its proposed local plant, to cost about $100,000.

BALTIMORE, MD.—The City Council contemplates replacing the gas lamps on York Road, between Thirty-fifth and Forty-second Street, with electric lamps and also on the Thirty-third Street Boulevard and Alameda Street. William A. Parr is superintendent of lamps and lighting.

CLARKSBURG, W. VA.—The Clarksburg Wholesale Company, recently organized, is considering the construction of an ice and cold-storage plant, to cost about $85,000.

HUNTINGTON, W. VA.—Bids will be received by the Board of Education of Huntington Independent School District until Jan. 11, 1924, for plumbing, electric wiring, and a clock and program system for the Lincoln Junior High School. Richard M. Bates, Jr., 414 Eleventh Street, is architect.

FREDERICKSBURG, VA. — Plans are being considered by the Spottylvania Power Company for the construction of two large hydro-electric plants on the Rappahannock River above the present development of the company. A large portion of the energy generated at the proposed plant will be transmitted to Richmond.

HAMPTON ROADS, VA.—Bids will be received by the United States Marine Corps, Quartermaster Department, Washington, D. C., until Jan. 3, for one light plant complete, at Hampton Roads. (Schedule 271.)

WASHINGTON, D. C.—Bids will be received by the Board of District Commissioners, District Building, until Jan. 9, for 28,372 ft. telephone and signal cable.

WASHINGTON, D. C.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, until Jan. 8, for 20,000 ft. of two-conductor cable, for the local naval station. (Schedule 1707.)

WASHINGTON, D. C.—Bids will be received by the purchasing agent, Panama Canal, until Jan. 11, for switchboards, electric motor, insulated cable, lamp cord transformers, etc. (Circular 1581.)

North Central States

DETROIT, MICH.—Plans are being prepared by Malcomson, Higginbotham & Palmer, 1219 Griswold Street, for twelve new buildings for the University of Detroit, including administration, general science, gymnasium, engineering, library, chapel, power house, etc., at Livernois Avenue and Six Mile Road.

MENOMINEE, MICH.—The City Council has approved the installation of electrically operated pumps in the municipal waterworks, to replace present steam equipment.

EAST LIVERPOOL, OHIO.—The Ohio Power Company has plans to erect a substation at Chester Avenue and Twentieth Street for power service for the Pennsylvania Railroad and industrial interests in the western section of the city.

LOUISVILLE, KY.—Plans are being prepared by the Louisville Hydro-Electric Company for the construction of a power house in Louisville. D. McDonald is engineer.

HUNTINGTON, IND. — The Northern Indiana Power Company plans to increase its capital stock by $1,500,000, part of the proceeds to be used for the purchase of local light and power properties and for expansion.

INDIANAPOLIS, IND.—The Indianapolis & Cincinnati Traction Company plans to make line extensions and improvements, including the installation of automatic substation equipment, for central-station service. It is proposed to discontinue operations at its Rushville power plant.

MARION, IND.—The Indiana General Service Company contemplates installing new equipment at its local power plant to replace the machinery recently damaged by fire, causing a loss of about $25,000.

TERRE HAUTE, IND.—Bids, it is understood, will soon be asked by the Terre Haute, Indianapolis & Eastern Traction Company for the construction of new shops and car barns.

CHICAGO, ILL.—Electric power equipment will be installed in the initial unit of the proposed plant to be erected by the Williamson Candy Company, 1038 North Ashland Avenue, to cost about $500,000.

CHICAGO, ILL. — The Public Service Company of Northern Illinois has issued $10,000,000 in bonds, the proceeds to be used for further expansion, including the construction of a new power plant at Waukegan.

GRAND TOWER, ILL.—The Central Illinois Public Service Company has petitioned the Public Service Commission for permission to erect a 66,000-volt transmission line from Grand Tower to Wolf Lake and an electric distributing system in Grand Tower.

KANEVILLE, ILL. — Plans are under consideration by the village officials to obtain electric service for the village. Electricity may be secured from the municipal electric plant at Elburn. At present the town is without electrical service.

CHILTON, WIS.—Plans have been prepared by the Wisconsin Public Service Corporation, Green Bay, for the erection of a transmission line to furnish electrical service in Jericho near here.

COON VALLEY, WIS.—Plans are under consideration for rebuilding the electric plant of the Coon Valley Electric Company, recently destroyed by fire. The loss is estimated at about $20,000.

GREEN BAY, WIS.—Plans are under consideration by the Council for the installation of additional pumping equipment at the waterworks, to be operated by electric or steam power.

MILWAUKEE, WIS. — The Board of Estimates has approved a bond issue of $150,000 in the 1924 budget of the city, the proceeds to be used for extensions and improvements to the ornamental and other street-lighting systems in various parts of the city. Electricity for maintaining the lamps is purchased from the Milwaukee Electric Railway & Light Company.

OCONOMOWOC, WIS.—Plans are being prepared for the installation of ornamental lamps on West Avenue, Milwaukee, North and South Main Streets. About 100 standards will be required, to cost about $25,000.

BEMIDJI, MINN.—Steps are being taken for the installation of a new street-lighting system. The work will be carried out by the Minnesota Electric Light & Power Company.

DULUTH, MINN.—Steps have been taken by the Hillisde Improvement Club for the installation of a new lighting system on the Becker and Huntington highways.

NEW PRAGUE, MINN.—Plans, it is reported, are under consideration for the construction of a power plant, in New Prague, to cost about $70,000, during the coming year.

WINONA, MINN.—The Wisconsin Railway, Light & Power Company plans improvements to its local plant, to cost about $35,000.

DES MOINES, IOWA—Work will start at once on the construction of a new steam-electric generating plant for the Des Moines Electric Company, a subsidiary of the Illinois Power & Light Corporation, at Des Moines, which will have an ultimate capacity of 200,000 kw. and will cost about $16,000,000. The first section will develop 35,000 hp. and will cost about $6,000,000.

GUTHRIE CENTER, IOWA.—The Iowa Electric Company is planning to make extensions and improvements to its local system.

STATE CENTER, IOWA — The Town Council is considering the purchase of forty ornamental lamps standards for lighting the town. Frank D. Paine, Ames, is engineer.

BOLIVAR, MO.—The Tri-Cities Power Company, recently incorporated, has awarded contract for construction of power house, to cost $40,000, and will erect about 28 miles of transmission line. M. B. Messler is chief engineer.

KANSAS CITY, MO.—Plans are being prepared by the Kansas City Cold Storage & Warehouse Company for the construction of a new plant, to cost about $1,250,000. The equipment will include ice-manufacturing and cold-storage apparatus.

RUSH TOWER, MO. — The Missouri Marble Quarries, Inc., Boatmen's Bank Building, St. Louis, contemplates building a power house at its proposed local plant, to cost about $150,000.

KANSAS CITY, KAN. — The Interstate Power Company, recently incorporated, plans to build a superpower plant to serve the territory bounded by Kansas City, Atchison and Topeka. W. D. Pratt of Fredonia, W. J. Breidenthal of Kansas City and others are interested in the company.

TOPEKA, KAN.—Petitions are being circulated requesting the installation of an ornamental lighting system, covering thirteen blocks in the business district (not now lighted), to cost about $11,700.

Southern States

HAYESVILLE, N. C.—The Hayesville Power Company, recently reorganized, contemplates extensions in its system.

STATE COLLEGE, N. C. — Plans are under way for the construction of a power house at the North Carolina State College, to cost about $65,000.

SPARTANBURG, S. C.—The Southern Power Company, Charlotte, N. C., has obtained options on property near Spartanburg, where it proposes to build an auxiliary steam-driven electric plant.

LUDOWICI, GA.—The installation of an electric light system in Ludowici is under consideration.

QUITMAN, GA.—The City Council has entered into a contract with the Valdosta (Ga.) Lighting Company to supply electricity here. The company plans to erect a transmission line from Valdosta to Quitman.

SAVANNAH, GA.—James Imbrie of Imbrie & Co., Ltd., 61 Broadway, New York, is reported to be planning to build a power house in connection with a proposed local fuel briquette plant, to cost about $1,000,000.

MARIANNA, FLA.—The Marianna Light & Power Company, which is planning to build a hydro-electric plant on the Chipola River, also contemplates erecting about 70 miles of transmission lines connecting Marianna, Blountstown, Altha, Cottondale, etc. The Southern Engineering Corporation, Albany, Ga., is engineer.

SOUTH JACKSONVILLE, FLA. — The Florida Paper Mills Company, a subsidiary of the Grass Fibre Pulp & Paper Company, Leedsburg, will soon begin work on the first unit of its proposed local mill, to cost about $250,000. The project includes a power house.

ARKANSAS CITY, ARK.—The Lambe & Denmark Light & Water Company plans to install additional equipment at its power house.

DUMAS, ARK. — The Stimson Lumber Company, Memphis, Tenn., contemplates the building of a power house at its proposed local mill, to cost about $125,000.

LITTLE ROCK, ARK.—The Arkansas Central Power Company contemplates extensions to its power plant on Arch Street, including switchboard, etc., to cost about $100,000.

MALVERN, ARK. — The Van Veneer Company is planning to purchase a 150-kw. generator and auxiliary equipment for its proposed local plant.

CHILDRESS, TEX.—The Texas Central Power Company plans to build a new power house here in the spring.

DALLAS, TEX.—Plans are under consideration for the installation of an ornamental lighting system on Ervay Street and on Young Street.

DALLAS, TEX.—The Texas & Pacific Railroad Company contemplates the construction of a power house at its proposed shops at Belt Junction, near Dallas, to cost about $500,000.

HILLSBORO, TEX.—The installation of electrically driven pumps to replace the present steam equipment at the municipal waterworks system has been authorized by the City Council.

PORT ARTHUR, TEX.—Electric power equipment will be installed by the Kansas City Southern Railway Company, Kansas City, Mo., at its proposed local grain elevator, to cost about $500,000. A. N. Reese, Port Arthur, is engineer.

SALADO, TEX.—Plans are being prepared by the Harrington Company, Houston Building, San Antonio, for the construction of a power plant, pumping plant, crusher, elevators, washer screens and bins, for which, it is understood, bids will soon be asked for. Owner's name is withheld.

Pacific and Mountain States

EVERETT, WASH. — Negotiations are under way with the Puget Sound Light & Power Company for extensions in the ornamental lighting system in the downtown section, totaling about 250 lamp clusters and poles.

NOOKSACK, WASH. — The Glen Echo Power Company has been granted a permit to build a power plant on Breckenridge Creek.

OKANOGAN, WASH.—The Washington Water Power Company will install additional equipment at its Similkameen power station to increase the output to 4,300 hp.

SEATTLE, WASH.—The Puget Sound Power & Light Company has awarded a contract to Stone & Webster, Inc., 147 Milk Street, Boston, for the installation of a fourth unit, consisting of a 20,000-kva. generator and a 23,000-hp. waterwheel, to operate under 440-ft. head, with a new steel penstock 1,800 ft. long, extension to power house, transformer and switching equipment. The cost is estimated at $1,060,000.

SPOKANE, WASH.—The Stevens County Light & Power Company plans to erect a 33,000-volt transmission line to the Old Dominion mining section, about 7 miles.

YAKIMA, WASH.—Plans are being revised and new bids will soon be asked for the installation of an ornamental lighting system in the downtown section.

GARIBALDI, ORE.—The Coast Power Company, Tillamook, has been granted a franchise to build a transmission line to Manhattan. A franchise has been secured.

MADRAS, ORE.—The Columbia Valley Power Company has tentative plans for the construction of a hydro-electric power plant in Deschutes County, with total capacity of 175,000 hp., to cost about $500,000.

LOS ANGELES, CAL.—Plans are under way for the installation of an ornamental lighting system on Cahuenga Avenue from Hollywood to Sunset Boulevards, pressed-steel standards to be used.

LOS ANGELES, CAL.—Bids will be received by Thomas Oughton, city purchasing agent, until Jan. 3, for electric cable. (Specification 806.)

LOS ANGELES, CAL. — The National Paper Products Company, 1789 Montgomery Street, San Francisco, plans to build a power house at its proposed local mills, to cost about $1,000,000.

LOS ANGELES, CAL.—The Los Angeles Concrete Tire Company, I. W. Hellman Building, has acquired a site at Mission Road and Fremont Avenue for its proposed new plant, to cost about $75,000. The plans provide for a power house.

MERCED, CAL.—The San Joaquin Light & Power Company has made arrangements with the Merced Irrigation District for the construction of a hydro-electric power plant at the proposed Exchequer dam.

NEWPORT BEACH, CAL.—The Orange County Box & Lumber Company, recently organized, contemplates the construction of a power house at its proposed mill in the Newport Harbor section, to cost about $100,000. The company was organized recently. C. S. Chapman and James Irvine, Jr., are heads.

REDLANDS, CAL.—Plans have been authorized for the installation of an ornamental lighting system on East State Street, for which bids will soon be asked.

RIVERSIDE, CAL.—The Southern Sierras Power Company is planning to build a hydro-electric power plant on the Owens River Gorge, Mono County, with an initial capacity of 13,500 hp., estimated to cost $500,000.

SAN DIEGO, CAL.—Steps have been taken by the Imperial Heights Club for extensions in the street-lighting system in the Imperial Heights section.

SAN FRANCISCO, CAL.—Bids will be received by the Board of Public Works until Jan. 9 for furnishing steel towers for transmission line for the Mocassin Creek power plant of the Hetch Hetchy project, to include 394 standard towers, 98 heavy-duty towers and 12 transmission towers with foundation steel and 60,000-lb. tower extension steel. The cost is estimated at $500,000.

NAMPA, IDAHO.—Plans are being considered for the construction of a municipal power plant to cost about $90,000.

Canada

NIAGARA FALLS, ONT.—The installation of a lighting system on the Niagara River Parkway, to cost about $30,000, is under consideration by the Queen Victoria Niagara Falls Park Commissioners.

PORT ELGIN, ONT.—The installation of electrically driven auxiliary pumps at the waterworks is under consideration. The cost is estimated at $25,000.

TORONTO, ONT.—The location of the proposed new tower line and the station for the Port Credit division of the Hydro radials is under consideration by the Mayor and Board of Control and the Hydro-Electric Power Commission of Ontario.

HAWARDEN, SASK.—The installation of an electric light plant in Hawarden is under consideration

Electrical Patents

Announced by U. S. Patent Office

(Issued Dec. 11, 1923)

1,476,678. DEMODULATING APPARATUS. H. A. Affel, Brooklyn, N. Y. App. filed Dec. 31, 1920. Signaling by means of carrier currents.

1,476,686. MULTIPLE-UNIT SYSTEM OF ENGINE-DRIVEN GENERATORS; A. F. Brotz, Kohler, Wis. App. filed Jan. 6, 1922. Circuit connections for self-starting engine-driven generators.

1,476,689. ELECTRICAL TESTING SYSTEM; A. G. Chapman, East Orange, N. J. App. filed Dec. 6, 1921. For determining magnitude of cross-talk between two adjacent circuits.

1,476,691. ELECTRICAL SIGNALING; L. Cohen and J. O. Mauborgne, Washington, D. C. App. filed Jan. 26, 1921. Elimination of static.

1,476,721. FREQUENCY-CONTROL SYSTEM; De L. K. Martin, Orange, N. J. App. filed Nov. 23, 1921. Control of carrier frequency used for signaling by different stations.

1,476,725. IGNITER FOR GASEOUS-FUEL BURNERS; H. C. Pope and J. H. Fieldhouse, Los Angeles, Cal. App. filed Nov. 16, 1921. By electric spark apparatus.

1,476,733. ELECTRIC-CURRENT GENERATOR; J. A. Smith, Syracuse, N. Y. App. filed July 28, 1922. Magneto built into flywheel of gas engine.

1,476,790. CENTRIFUGALLY OPERATED CIRCUIT-CONTROLLING DEVICE; M. W. Bartmess, Cleveland, Ohio. App. filed Feb. 18, 1922. For repulsion-type induction motors.

1,476,940. COMMUTATOR-COOLING APPARATUS; N. Wilkinson, Wauwatosa, Wis. App. filed April 28, 1921.

1,476,941. ELECTRIC CABLE-WINDING MECHANISM; W. A. Young and F. Brill, Milwaukee, Wis. App. filed Jan. 15, 1923. Taking up and paying out cable of hoisting apparatus.

1,476,947. WINDING SECURING MEANS FOR DYNAMO-ELECTRIC MACHINES; A. J. Brown, Milwaukee, Wis. App. filed July 18, 1921.

1,476,953. TELEPHONE APPARATUS; W. L. Davis, Chicago, Ill. App. filed Dec. 6, 1920. Company telephone system.

1,476,978. SYSTEM OF CONTROL; F. Jeffrey, Milwaukee, Wis. App. filed Sept. 20, 1919. Motor-generator set for electric furnaces to reduce peak loads.

1,476,982. ADAPTER; T. J. Kerwin, Chicago, Ill. App. filed July 16, 1921. Standard screw plug with Ediswan type socket.

1,476,986. VENTILATING-DUCT CONSTRUCTION FOR DYNAMO-ELECTRIC MACHINES; W. W. Kusterman, Cincinnati, Ohio. App. filed Sept. 22, 1919.

1,476,997. SPEED-CONTROL SYSTEM; W. N. Motter, Milwaukee, Wis. App. filed Nov. 3, 1919. For steel, paper or sugar mill motors.

1,477,009. DEVICE FOR HEATING FORGING PIECES BY ELECTRIC RESISTANCE HEATING; E. Schröder, Berlin, Germany. App. filed July 6, 1921. Similar to butt-welding machines.

1,477,017. CURRENT-CONTROLLING AND STATIC REDUCING SYSTEM; C. A. Sprague, East Orange, N. J. App. filed May 2, 1919. Receiving weak signals in presence of static.

1,477,057. ARC LAMP FOR PHOTOGRAPHIC AND OTHER PURPOSES; B. J. Hall, Fieldend, Eastcote, and C. F. G. Thorkelin, London, England. App. filed April 1, 1920.

1,477,086. PROCESS FOR THE ELECTROLYTIC PRODUCTION OF POTASSIUM BICARBONATE FROM POTASSIUM-CHLORIDE SOLUTION; R. Suchy, Griesheim-on-the-Main, Germany. App. filed Aug. 24, 1921. By diaphragm process.

1,477,088. APPARATUS FOR PURIFYING LIQUIDS; R. C. Turner, Columbus, Ohio. App. filed May 19, 1919. By electric current.

1,477,099. ANODE FOR FORMING PERCOMPOUNDS; J. Baum, Carinthia, Austria. App. filed Aug. 22, 1922. Consists of tantalum partly coated with platinum.

1,477,109. PROCESS FOR THE MANUFACTURE OF ZINC CYLINDERS FOR PRIMARY BATTERIES; S. O. Copwer-Coles, Sunbury-on-Thames, England. App. filed May 11, 1920. For flashlight batteries.

1,477,149. CONTROL PANEL FOR HEATING EQUIPMENT; O. G. Pouch, New York, N. Y. App. filed March 22, 1921. Thermostat control apparatus to maintain constant temperature.

1,477,174. VULCANIZER; J. C. Heintz, Lakewood, Ohio. App. filed Sept. 9, 1920. Electric heating element.

1,477,197. STORAGE-BATTERY SYSTEM; R. H. Sullivan, Rochester, N. Y. App. filed July 26, 1922. System for charging battery from automobile generator.

1,477,271. MULTI-FREQUENCY GENERATOR; F. Lowenstein, Brooklyn, N. Y. App. filed Dec. 9, 1918. For wireless-telegraph apparatus.

1,477,285. COMBINED STOP LIGHT AND TAIL LAMP; H. A. Rippner, Cleveland, Ohio. App. filed March 14, 1923.

1,477,303 to 1,477,306. PROTECTIVE DEVICE; C. T. Allcutt, Wilkinsburg, Pa. App. filed Feb. 8, 1918. Lightning-arrester gap.

1,477,308. GAP IONIZER; Q. A. Brackett, Pittsburgh, Pa. App. filed Jan. 16, 1919. Horn gap of electrolytic lightning arrester made of film-forming metal.

1,477,309. SPEED-REGULATOR SYSTEM; W. M. Bradshaw, Wilkinsburg, and C. A. Boddie, Pittsburgh, Pa. App. filed April 9, 1919. Maintaining generator speed constant.

1,477,313. ELECTRIC FURNACE; O. A. Colby, Irwin, Pa. App. filed Sept. 23, 1921. Removable resistor type.

1,477,314. ELECTRIC FLATIRON CUT-OUT; O. A. Colby, Irwin, Pa. App. filed Sept. 28, 1921.

1,477,316. RADIO-MODULATION SYSTEM; F. Conrad, Pittsburgh, Pa. App. filed July 11, 1922. Telephone transmitting apparatus.

1,477,326. ELECTRIC IRON; H. S. Dodd, Toronto, Ontario, Canada. App. filed June 13, 1921. Cut-out switch closed when handle is clasped.

1,477,339. IMMERSION WATER HEATER; F. F. Forshee, Flint, Mich. App. filed Dec. 7, 1920. Circuit can only be closed when heater is in liquid.

1,477,340. ELECTRIC COFFEE PERCOLATOR; F. F. Forshee, Flint, Mich. App. filed Dec. 17, 1921.

1,477,343. ROTARY-TOASTER STOVE; G. B. Griffin, Springfield, Mass. App. filed Dec. 16, 1920. To toast bread evenly.

1,477,347. RESISTOR SUPPORTING MEANS FOR ELECTRIC RESISTANCE FURNACES; H. A. Hands, Swissvale, Pa. App. filed Jan. 20, 1922.

1,477,354. METHOD OF TREATING AND RESTORING USED STORAGE BATTERIES; M. E. Hunt, Belle Plaine, Iowa. App. filed Oct. 27, 1922. By thoroughly drying plates.

1,477,359. STATIONARY INDUCTION APPARATUS; S. E. Johannesen, Pittsfield, Mass. App. filed April 11, 1921. Distributed core construction.

1,477,366. LIGHTING FIXTURE; B. F. Klein, Cleveland, Ohio. App. filed June 29, 1921. Indirect lighting unit.

1,477,367. ELECTRIC REGISTER; O. A. Knopp, Oakland, Cal. App. filed March 1, 1920. Apparatus registers simultaneously on one dial record of two meters located at distant point.

1,477,372. MEANS FOR PRODUCING A SOOTY VAPOR IN ELECTRIC FURNACES; G. M. Little, Pittsburgh, Pa. App. filed March 23, 1922. For burning out soot in resistance furnace.

1,477,375. ELECTRICALLY OPERATED WARNING HORN; R. W. Maudslay, Coventry, England. App. filed July 15, 1922. Vibrating type.

1,477,377. SYSTEM OF CONTROL; H. D. Murdock, Wilkinsburg, Pa. App. filed March 30, 1921. Protecting railway motors from overloads.

1,477,384. ELECTRIC RESISTANCE FURNACE; T. A. Reid, Wilkinsburg, Pa. App. filed Feb. 23, 1922. Small furnace.

1,477,385. ELECTRIC FURNACE; T. A. Reid, Wilkinsburg, Pa. App. filed Feb. 23, 1922. Resistance type.

1,477,387. TROLLEY FROG; W. Schaake, Pittsburgh, Pa. App. filed Jan. 7, 1922. For overhead wire.

1,477,395. AUTOMATIC RECLOSING CIRCUIT-BREAKER SYSTEM; O. C. Traver, Schenectady, N. Y. App. filed Jan. 19, 1922. For direct-current systems.

Vol. 82, *No.* 26 New York, December 29, 1923 *Pages* 1303-1352

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CONTENTS

Men Who Create 1303

Frontispiece—Sidney Borden Paine 1304

Editorials 1305

Tests on Accuracy of Reactive Metering 1309
BY ARCHER E. KNOWLTON.
The experimental and theoretical analyses as given in this article should clearly indicate the possibilities, limitations and accuracy of present methods.

Coal Handling at Zilwaukee 1314
BY H. F. EDDY.

Reproduction and Investment Costs as Rate Bases 1317
BY L. R. NASH.
A discussion which shows the increasing recognition that is being given to the present cost of reproduction as a rate base.

System Maintenance and Inspection 1319
BY JAMES E. JORDAN.
Describing a decided innovation made in connection with a company's light and power distribution and transmission systems.

Governor of Arizona States His Stand on Colorado River Situation 1322

Letters from Our Readers 1322

Departments

Central-Station and Industrial Practice 1325
Central-Station Business 1329
Digest of Electrical Literature 1332
News of the Industry 1334
Associations and Societies 1341
Court Decisions and Commission Rulings 1342
Men of the Industry 1343
Manufacturing and Markets 1344
Business Conditions 1346
Activities of the Trade 1348
Construction News 1350
Electrical Patents 1352

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"New Equipment Available"

IT IS felt that the readers of the ELECTRICAL WORLD desire and deserve a somewhat more extended description of new equipment than our present plan allows.

Beginning with the Jan. 5, 1924, issue of the ELECTRICAL WORLD the present "New Apparatus and Publications" section will be divided. "New Publications" will continue in the present location as "New Trade Literature." "New Equipment Available" will be a new sub-heading to follow "Activities of the Trade."

The purpose is to give to the engineer or user in the field a sufficient description of the principles or characteristics of new equipment available to enable him to judge as to whether the particular equipment is likely to be of use to him.

Only that equipment which really embodies some new feature will thus be included, except that announcements of new lines will be made. Illustrations will be used when necessary to the description of the equipment.

We believe that this improved method of handling this subject will be a real service to the readers of the ELECTRICAL WORLD.

Advertising Index—Alphabetical, 76; Classified, 70, 72, 74; Directory of Engineers, 36, 37; Searchlight, 38-46

Economical Loading of Distribution Transformers

"Loading distribution transformers on a temperature basis as a means of more economical operation is receiving serious consideration of Central Station companies .... The interest of the Central Station is to secure the maximum possible output from the transformer without loss of an unreasonable number of units by overload."

Electrical World, Dec. 15, 1923

and

read this from the paper of the Electrical Apparatus Committee of the N. E. L. A. as reported in Electrical World, June 9, 1923.

...g up with on... ...the bi...

Various opinions have been expressed regarding the features which should be incorporated in temperature indicators for distribution transformers. Among them are: (a) The device must be low in first cost and maintenance expense; (b) it must be compact, easily installed and readily visible from the ground; (c) it must be easily and quickly reset; (d) it must be positive and reliable; (e) it must be weatherproof.

Rules governing the installation and use of moto... ...distributio... ...been

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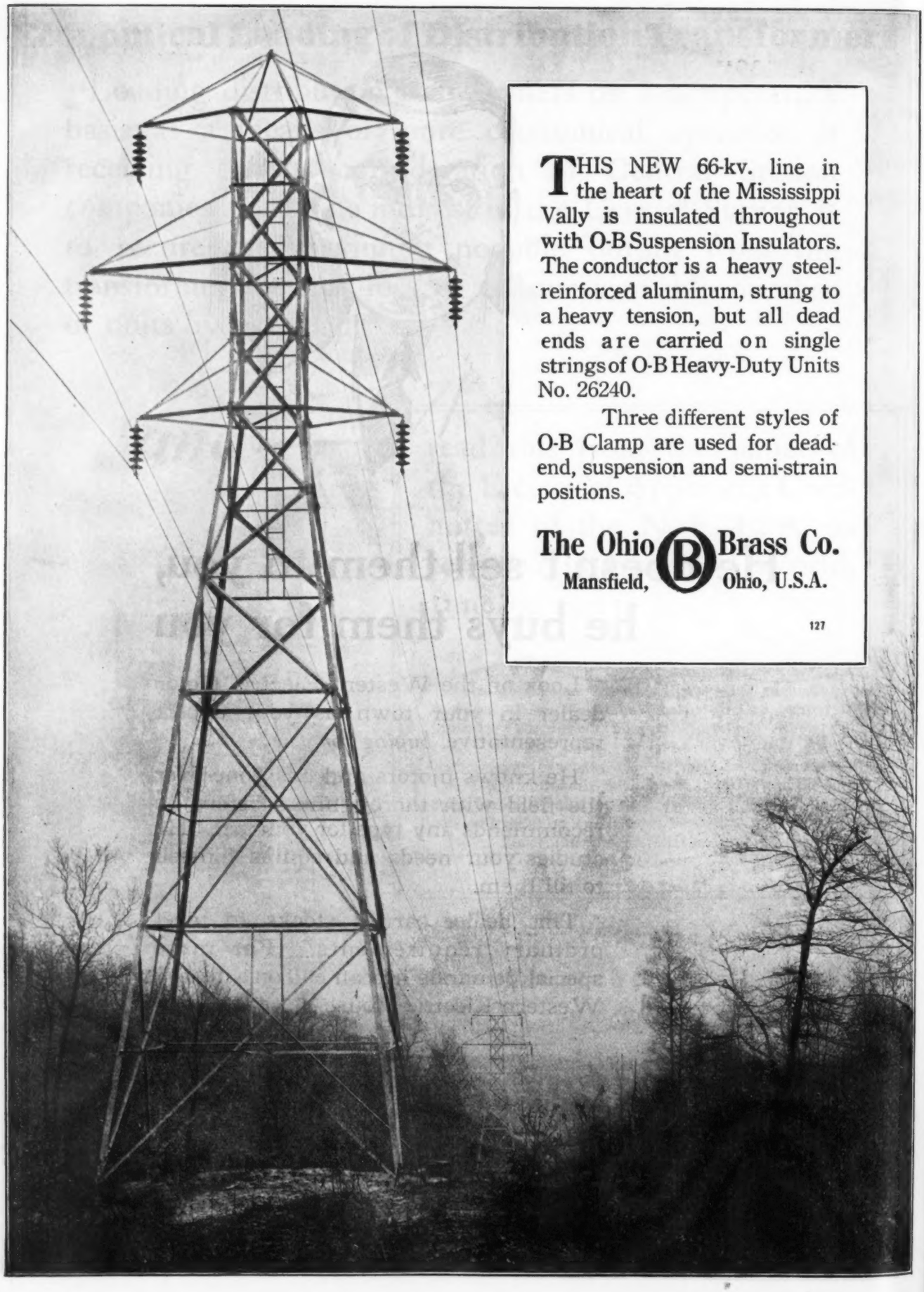

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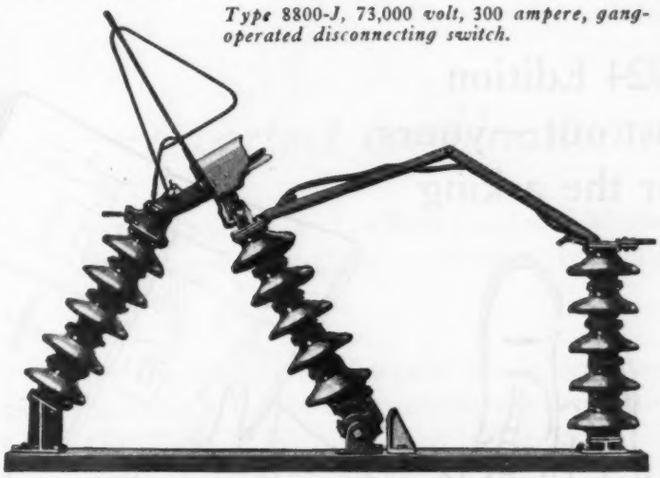
the 100% SWITCH



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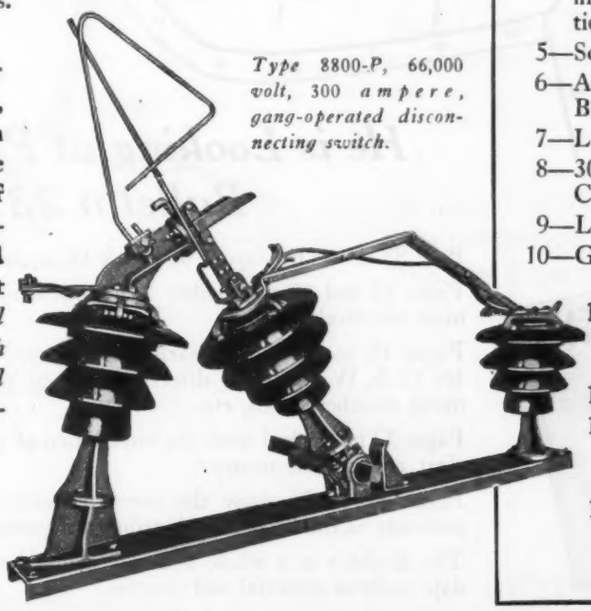

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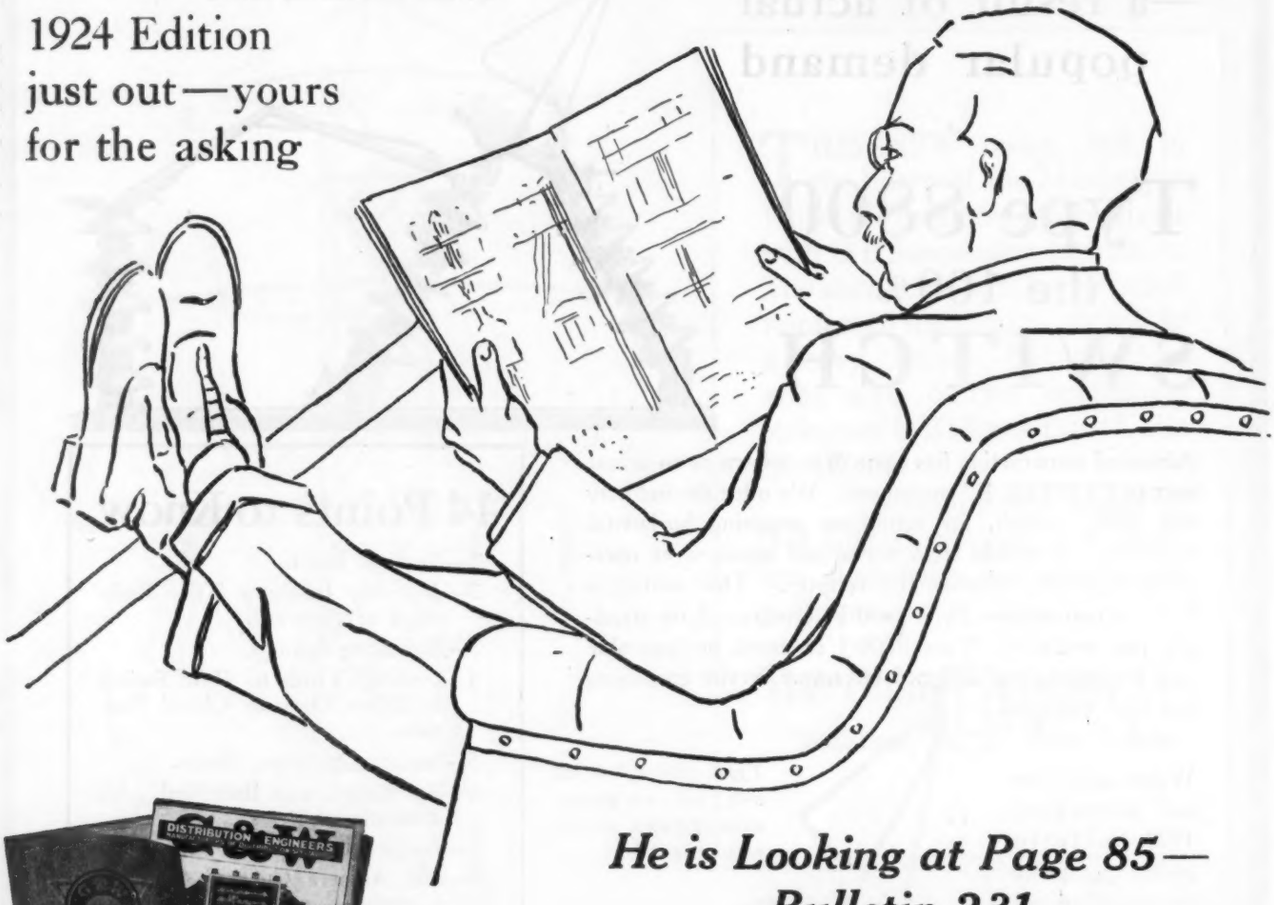

He is Looking at Page 85— Bulletin 231

Page 85 shows the layout of a G & W equipped transformer vault.

Pages 77 and 87 show other layouts in which G & W devices are most effectively applied.

Pages 16 to 19 show clearly various top constructions available for G & W potheads, direct connection round or flat bus bars, metal weather hoods, etc.

Pages 22 to 32 deal with the installation of potheads in a complete, clear and concise manner.

Pages 32 to 35 show the interconnection feature of G & W potheads as the basis of a distribution system.

The Bulletin as a whole is a very comprehensive catalog of up-to-date pothead material and practise.

Bulletin 232 offers an equally wide selection of underground box construction, with approximate prices, which will enable you to make comparisons in estimating work.

An oil-filled cutout arrangement on Page 132 and several types of box construction not listed in our order catalogs merit your investigation.

These Bulletins (231 and 232) contain many points of value to every electrical engineer, operating executive and foreman. *If you haven't received your copy, ask for it.*

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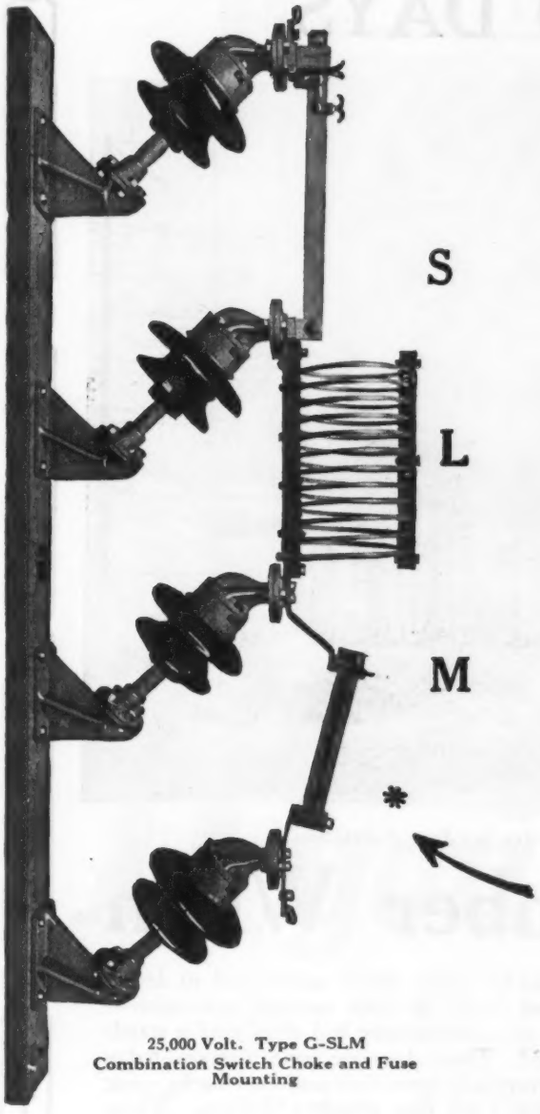

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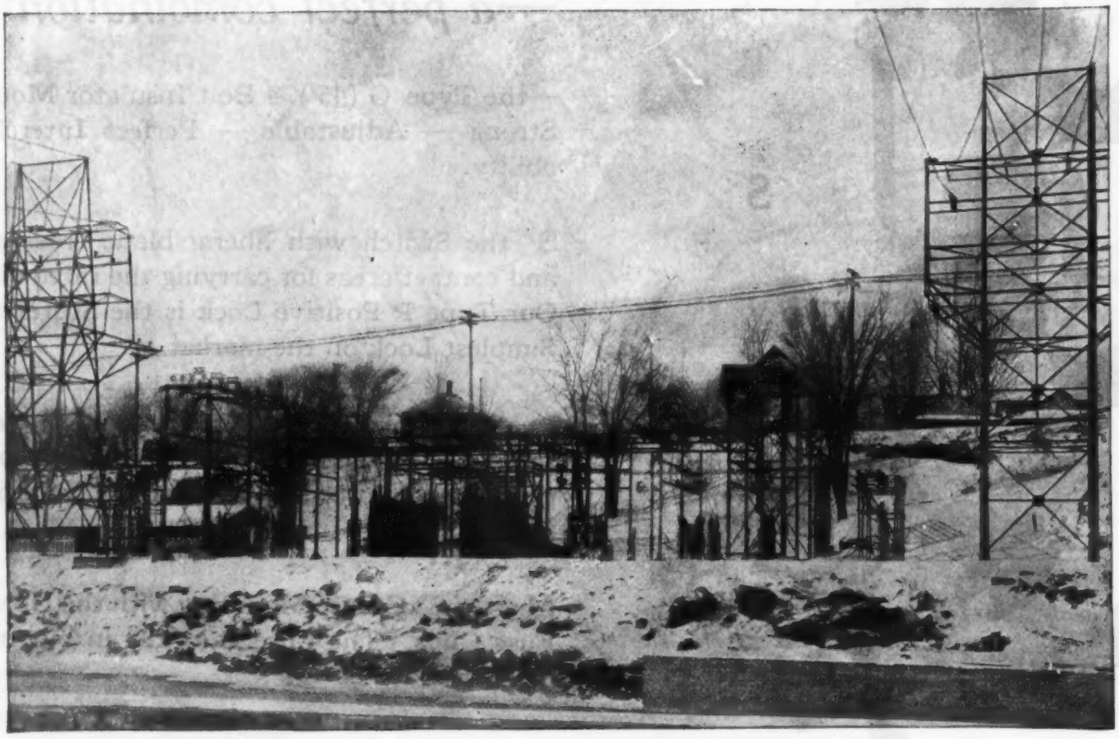

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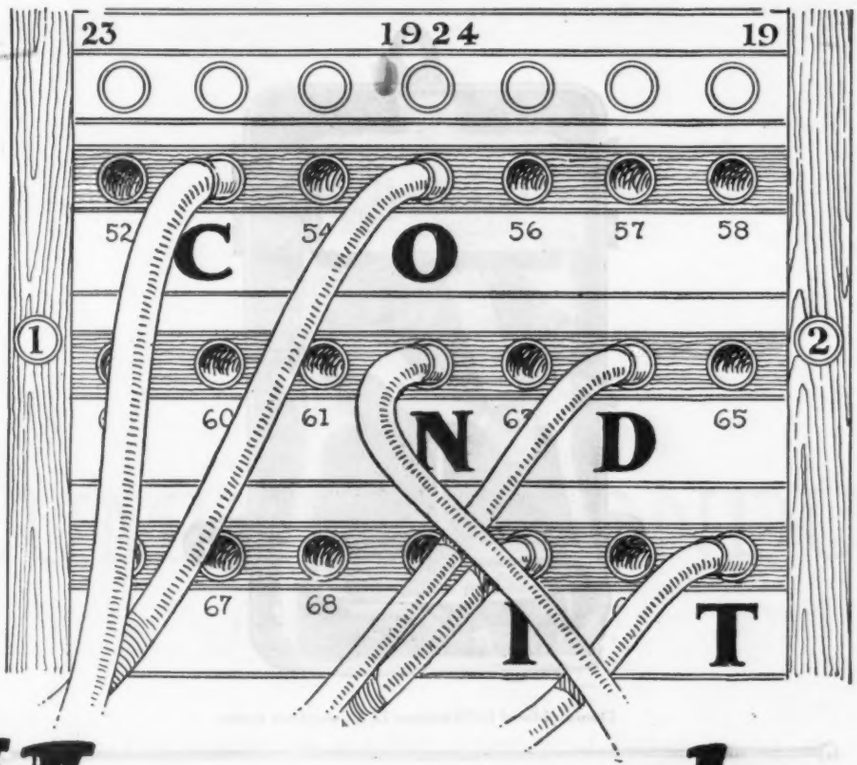
DELTA-STAR

The Standard of Comparison

UNIT TYPE INTERCHANGEABLE PARTS



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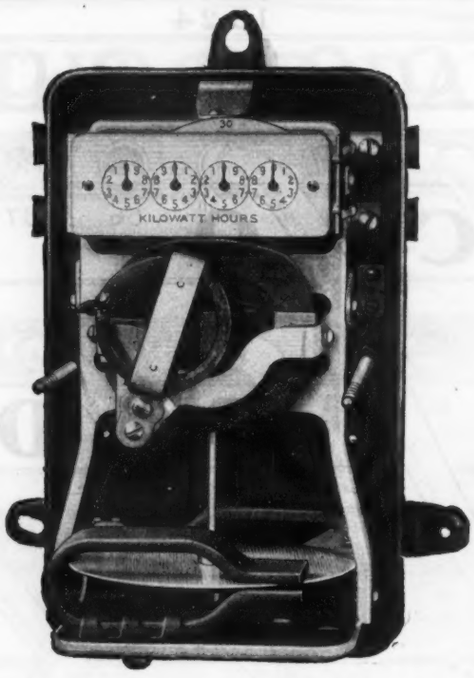

Duncan Model E. 50 ampere D. C. watthour meter

Consider the Importance of Watthour Meters

Consider the importance of watthour meters. They're only one detail in the operation of a utility property, and they don't cost very much, each. But they guard your revenue, your energy, your customer's good will. They may also be an important factor in maintenance charges, if they're not adequate, up-to-date meters.

Just like the fat-man's suspenders. Not so very expensive, maybe, but very important, nevertheless.

The fact that most meters for consumer use look very much alike makes it easy to regard them as very much alike inside the case, and therefore, similar in service rendered. This is not strictly true, of course.

Accuracy and life and maintenance requirements are not at all alike. Which means, too, that the cost of adequate metering varies considerably.

Duncan Model M-2 watthour meters are made with an accuracy that is considered remarkable by experienced meter engineers. Their variation under the changes taking place in every-day use is unusually small, and they retain this character of performance over very long periods.

We are glad to demonstrate the superiority of Duncan Meters, or we will send you bulletins describing them fully.

DUNCAN ELECTRIC MANUFACTURING CO.
LAFAYETTE, IND.

ALUMINUM CONDUIT

for exacting duty:

Use aluminum conduit where acid fumes in battery rooms, flue gases along railroads and acid in cinder fill shorten the life of ordinary conduit. Aluminum conduit is rustless—it resists the action of moist or salt air.

Aluminum conduit has no thin protective coating to be broken down by corrosion or abrasion. Its wall is solid aluminum, the lightweight and durable metal.

Aluminum Company of America
Oliver Building, Pittsburgh

OFFICES

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Boston	Newark
Buffalo	New York
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Aluminum Company of America
Gentlemen:

I am interested in aluminum for.....

.....

Please send ☐ Representative
☐ Information
☐ Sample

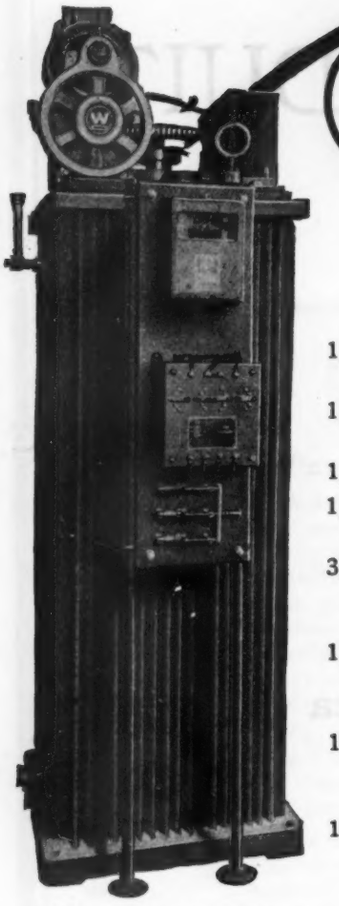
.....

W. .....

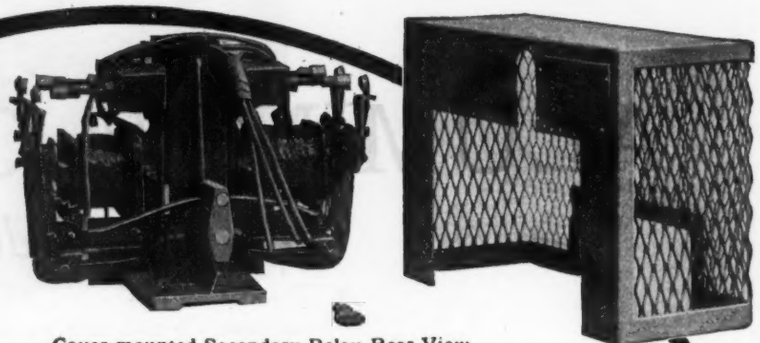
Please mail Coupon to nearest office.

Close Voltage Regulation

The close voltage regulation of **Westinghouse Induction Voltage Regulators** is due to the high-speed operation of the primary relay, and of the cover-mounted secondary relay and motor.



46-Kv-a Standard Regulator, Complete with Panel and Automatic Accessories



Cover-mounted Secondary Relay Rear View

1/10 seconds after the feeder voltage changes, the primary-relay contacts close.

1/30 seconds after the primary-relay contacts close, the secondary-relay contacts close.

1/10 seconds after the primary-relay contacts close, the motor starts.

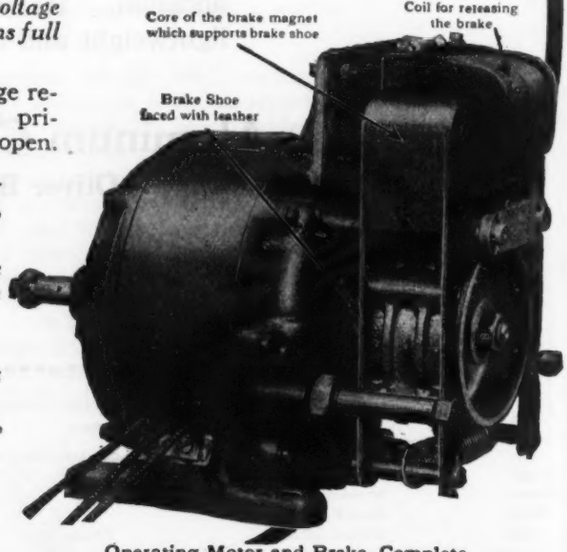
1/5 seconds after the primary-relay contacts close, the motor attains full speed.

3/10 *seconds after the feeder voltage changes, the motor attains full speed.*

1/20 seconds after the feeder voltage returns to normal, the primary-relay contacts open.

1/20 seconds after the primary-relay contacts open, the motor stops.

1/10 *seconds after the feeder voltage returns to normal, the motor stops.*



Operating Motor and Brake, Complete

Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pennsylvania
Sales Offices in All Principal Cities of the United States and Foreign Countries

Westinghouse

A grade

for each requirement

and each grade uniform in quality. An examination and comparison by test of competitive brands of tape will show that Westinghouse Friction Tapes are superior. They are easily handled, do not ravel, run easy, and have good adhesive and insulating qualities.

Durability, strong adhesiveness and full yardage, which are the principal requirements necessary, are marked characteristics of all grades of Westinghouse Tapes.

Westinghouse Electric and Manufacturing Company
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Sales offices in principal cities of the United States and Foreign Countries

Adhere Friction Tape
A low-priced tape of exceptional qualities. Recommended for outdoor as well as indoor use on all classes of electrical construction.

IXL Friction Tape
A medium-priced tape of maximum yardage, particularly valuable in general Industrial, Electric Railway and Central Station work.

Westinghouse Friction Tape
Straight and Bias
This is a tape of the very highest quality and is recommended for permanent work where service conditions are severe.

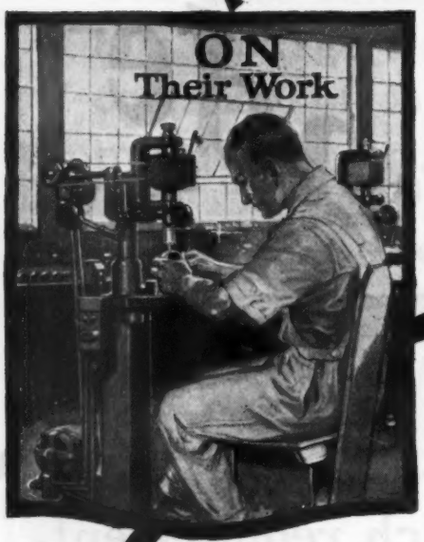
Westinghouse Splicing Compound
Westinghouse Splicing Compound is composed of the highest grade of unvulcanized rubber. Recommended for heavy-duty splicing service where the best grade of compound is required.

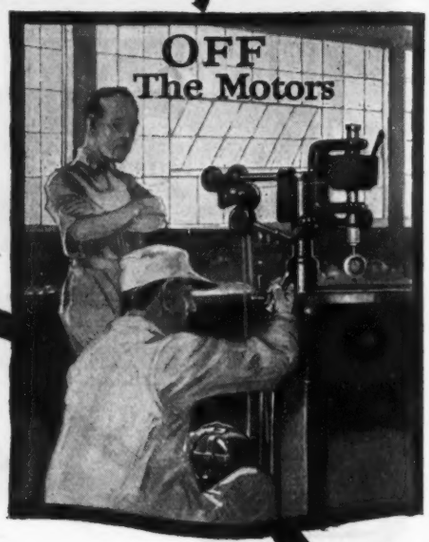
Pittsburgh Splicing Compound
A low-priced tape of exceptional dielectric and mechanical value. Recommended for general applications.

Armature Tape
A high grade white tape, frictioned on one side only, for insulation on armature coils.

For Speed and Economy of Operation

Keep Their Minds





W
WESTINGHOUSE ELECTRIC

A Necessity for Direct-Drive Machinery

Snap! A turn of the button on the WK Motor Starter and production *goes ahead.* These up-to-date, compact, convenient safety motor starters fully protect the motors. No more delays; no more burning out of small motors; no more motor trouble for the "trouble man".

WK-10
For motors up to 2 H. P.

WK Motor Starters are designed specifically to protect small motors. They can be mounted where your mechanics can get at them. They are simple and easy to install and operate. They are small and do not obstruct light. They are fully equipped with up-to-date and positive quick-make and quick-break features.

WK-20
For motors from 2 to 5 H. P.

They fill a long felt need. They have been designed not only for the purpose of protecting the motor but also to give a full measure of protection to the operator; and electricians in hundreds of plants can tell you how well these starters have helped them keep their plants running to the maximum efficiency.

One of the secrets of their unique effectiveness is the time element feature which takes care of harmful overloads in an absolute, positive way. You will be amazed to find how economically you can equip your plant with the WK-10 and WK-20 Motor Starters.

Westinghouse Electric & Manufacturing Co.
Mansfield Works, Mansfield, Ohio

Westinghouse

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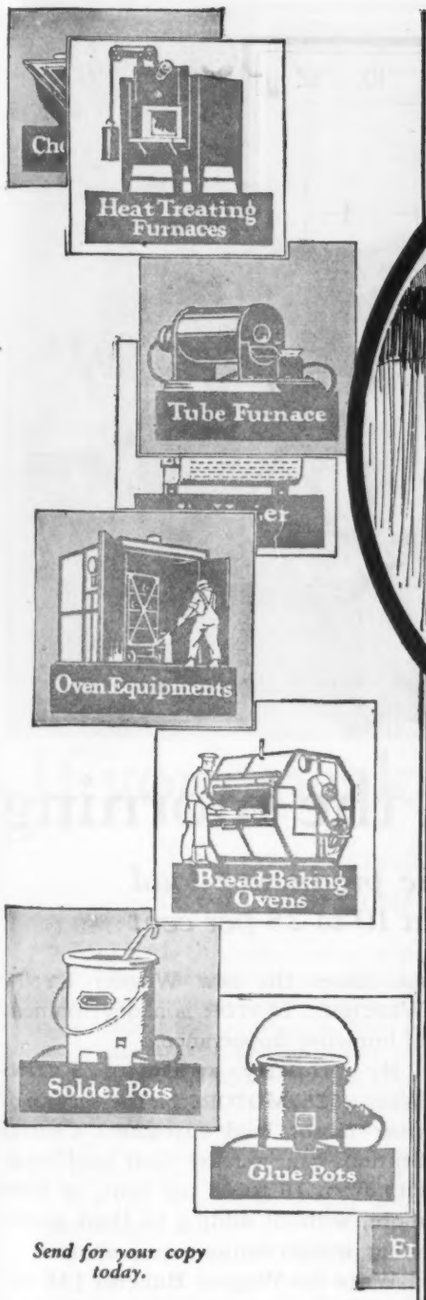


Electric heat has many uses. A few of these applications are suggested by the small sketches. Electric heat can be used in your business.

Make It Warm for Your Watchman

Your watchman is human, and like others, he cannot work efficiently when cold. Two or three space heaters in the sentry house will keep him warm in the coldest weather, at a surprisingly low cost, and without danger of fire.

The duties of a crane man require that he be ready to promptly respond to exacting responsibility at any time. If his crane cab is chilly, if his fingers are stiff, he will not be able to properly control his crane. Westinghouse space heaters will increase the efficiency of your crane man by keeping him warm.

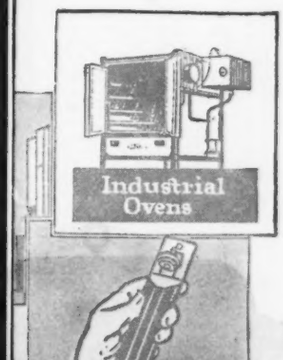
Order a box of these convenient heaters today, and have your electrician install them in some of those hard-to-heat places around the plant. Then you won't have to worry about the heating problem.

Get in touch with the nearest Westinghouse sales office today. The office representative will gladly give you data on the various sizes.

Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pennsylvania

Sales Offices in All Principal Cities of the United States and Foreign Countries

Consult your telephone directory



Send for your copy today.

An occasional publication containing accounts of heating installations of interest to every executive. We will be glad to put you on the mailing list. Write for a copy today.

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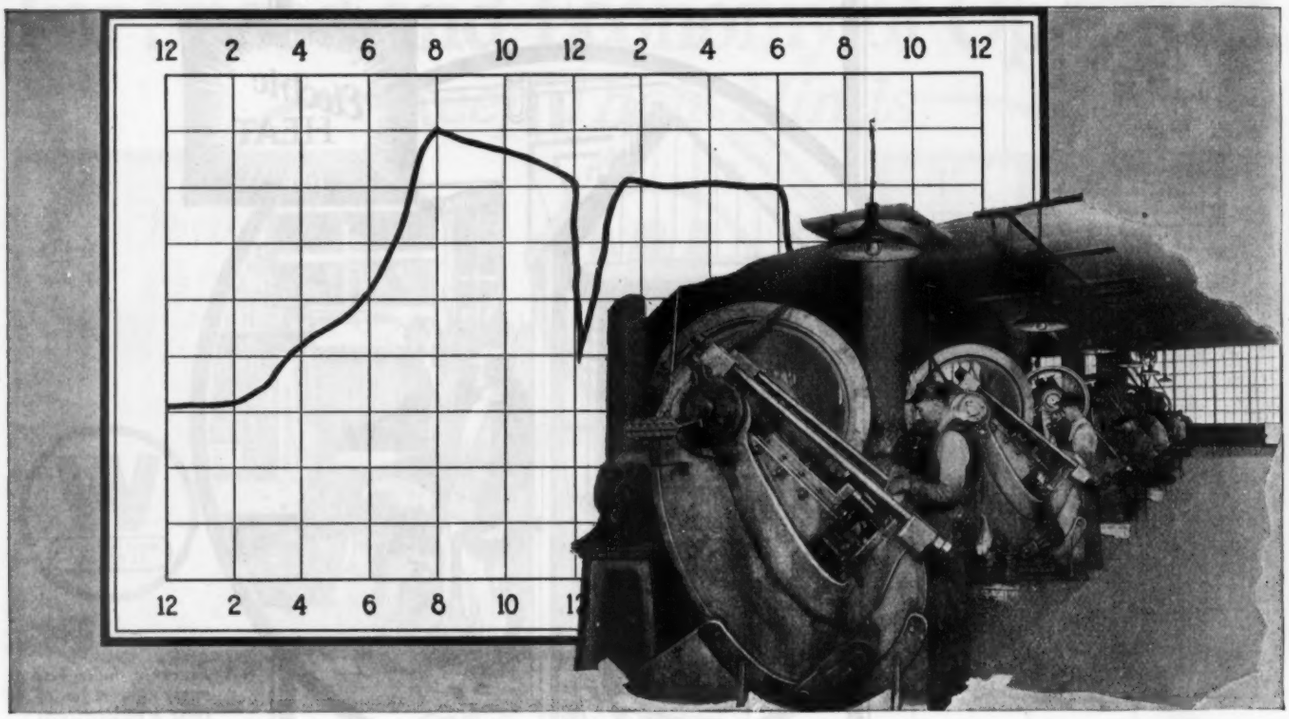


If your peak load comes in the morning

You can increase the productive load capacity of your plant 10 to 25 per cent

CENTRAL Stations having a load which reaches its daily peak in the morning are almost invariably heavily handicapped by low power-factor.

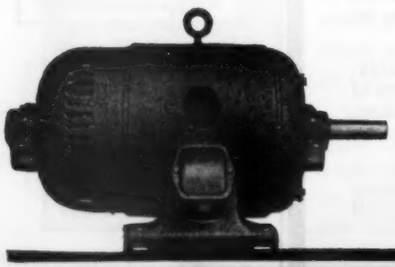
This is of course due to the fact that usually such loads are nearly all induction motor load.

As the predominance of motor load increases power-factor declines until an economic limit is reached at which no more power load can be taken without increasing the capacity of the Central Station plant.

Companies in such circumstances are in a serious position. To these companies the new Wagner FYNN-WEICHSEL MOTOR is a development of immense importance.

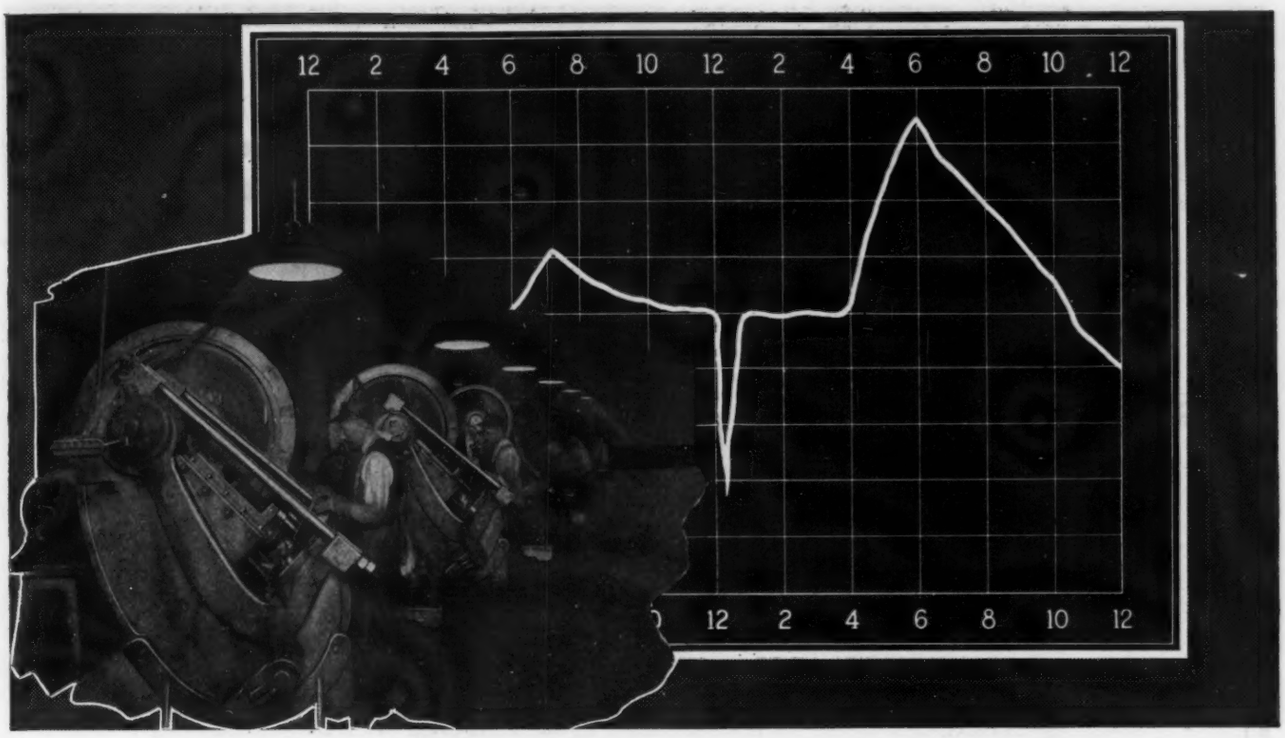
By properly applying FYNN-WEICHSEL MOTORS to the service of their motor load customers Central Stations can increase their load capacity from 10 to 25 per cent, or even more, without adding to their generating or distribution equipment.

Write for Wagner Bulletin 134, explaining how this is accomplished by the Wagner FYNN-WEICHSEL MOTOR — the motor that corrects power-factor.



Fynn-Weichsel

The motor that corrects power-factor



If your peak load comes in the afternoon

You can increase the productive load capacity of your plant 10 to 15 per cent

CENTRAL Stations having a peak in the afternoon usually have somewhat better power-factor than those with a morning peak. This is of course due to the fact that the afternoon peak generally includes considerable lighting load which has a higher power-factor than the motor load. Of course, the earlier the peak occurs the less the proportion of lighting load will be and the power-factor will be correspondingly worse.

By introducing FYNN-WEICHSEL MOTORS into operation where induction motors are used, Central Stations with an afternoon peak can effect a marked improvement in power-factor conditions, with a resulting increase in the capacity of the Central Station system. Conservatively estimated, the increase in capacity which such companies can obtain by this means would average 10 to 15 per cent.

In other words, without adding a dollar to plant investment these Central Stations can release for direct revenue-producing service, 10 to 15 per cent of their plant capacity now tied up in handling idle current for which no revenue whatever is received.

Without expense to the Central Station THE FYNN-WEICHSEL MOTOR effects this revolutionary service—and at the same time saves the consumer money on present power losses. Write for Wagner Bulletin 134.

WAGNER ELECTRIC CORPORATION
SAINT LOUIS

WAGNER ELECTRIC CORPORATION You may send me—without obligation on my part—a copy of your bulletin No. 134, describing THE FYNN-WEICHSEL MOTOR.	NAME
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8420-10

Emergency Service

WHEN your motor or generator fails because of brush trouble—of worn out brushes or incorrect grades— When you need brushes on short notice—

Write—Phone—Wire

to our nearest brush plant for *immediate* service.

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Grit Completely Excluded

From Sand-Covered Ball Bearing Motor

AS the driving unit of a core sand-mixer, this totally-enclosed, self-ventilated motor operates under conditions that would soon send a plain-bearing equipped motor to the repair shop. Yet the manufacturer claims for this motor a non-maintenance service record.

This performance is largely the result of mounting the rotor on Skayef self-aligning ball bearings mounted in proper housings which by effectively preventing the entrance of fine abrasive particles, enable one to obtain the full benefits of the non-wearing feature of ball bearings.

Not only in this application, but in many others of like and different nature, self-aligning ball bearings are daily demonstrating their superior performance, requiring little attention, few lubricant replenishments and maintaining indefinitely a true running and permanently centered shaft.

The accumulated experience of our engineering staff is at your disposal.

THE SKAYEF BALL BEARING COMPANY

Supervised by SKF INDUSTRIES, INC., 165 Broadway, New York City

1092

Normal View *Deflected View*

BALL BEARINGS

The Highest Expression of the Bearing Principle

3 Inches in a Minute

Can you do this?

Do you know of an electric hammer-drill that will go through a three inch concrete slab in one minute? The SYNTRON will.

The lightest electric power hammer and drill on the market, it has only one moving part, makes 3600 strokes per minute and is impossible to get out of order. It can be attached to any electric light socket.

Furnished complete in cases for carrying, with an assortment of tools for all types and sizes of work.

This hammer is a necessity where any amount of chipping or drilling is done. We can prove it in dollars and cents. *Write for details.*

Fill out and mail the coupon, today, for prices and complete description of the Syntron Electric Hammer.

National Electric Mfg. Co.

610 Chatfield & Woods Building, Pittsburgh, Pa.

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Three Types

Type F-Weight 9 Pounds
Capacity ⅜ inch
Type A-Weight 17 Pounds
Capacity 1 inch
Type B-Weight 26 Pounds
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For

Drilling through masonry walls
Drilling holes for expansion bolts
Chipping and cracking stone
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Driving rivets
Light assembly work of all kinds
Squaring or breaking up stone and pavements
Calking pipes, tanks, plates, etc.
Vibrating
And any purpose where the rapid strokes of a hammer can be used

National Electric Mfg. Co.,
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Please send me, without obligation on my part, catalog and prices on the Syntron Electric Hammer.

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Electrical Maintenance and Repair—

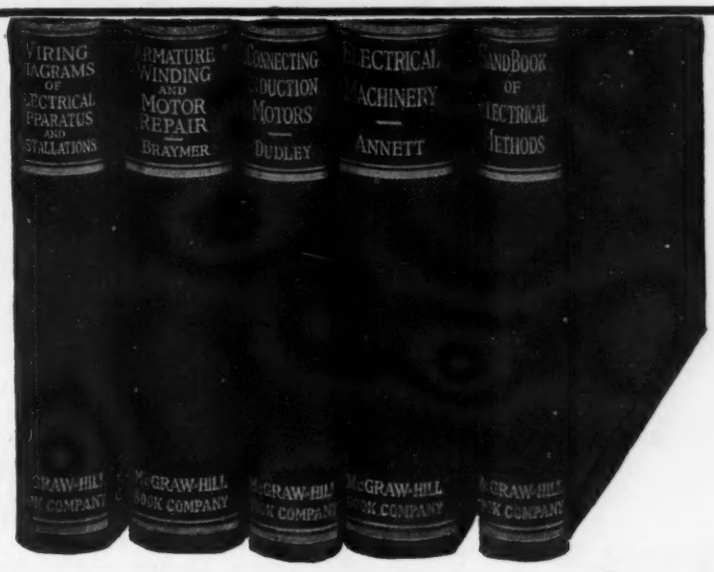
5 volumes—1736 pages—1818 illustrations—library binding

THESE five volumes contain the largest collection of practical methods for electrical repair and maintenance men ever put together in book form.

Every one of the books is jammed from cover to cover with good, sound, how-to-do-it information—the kind you have to have when anything goes wrong.

They cover every phase of electrical repair and maintenance work from armature winding to the correction of brush troubles. And the treatment is always from the practical man's standpoint.

Fundamental laws and rules are discussed when necessary, but there is no hard-to-understand theory or discussion of design. All of the material presented in these five books has been obtained from actual experiences. The library outlines the practical remedies that have been applied by repairmen all over the country in the solving of puzzling electrical problems



These books tell you

How to replace commutator segments—
How to connect an induction motor winding to meet any condition of voltage, phase, frequency and speed—
How to check this reconnection to know if the motor will operate under the new condition—
How to draw a diagram for any winding—
Ten most common defects in windings—
How to locate defects—
How to figure a new winding for an old core—
How frequency affects winding and r.p.m.—
How performance is affected by a change in winding—
How to find out what the trouble is when a motor or generator will not run—
How to remedy the trouble—
How to keep electrical machines in first-class operating condition—
How to re-arrange a three-wire system to reduce voltage fluctuations—
How to test meters—
How to turn down a commutator—
How to insert spare transformer in star-delta group—
How to remove defective field coils—

And hundreds of other practical methods and kinks

Seven good reasons why you should have these books

1. The five books in this library discuss actual repair jobs and show you step by step what to do when anything goes wrong.
2. They show you how to locate and remedy motor and generator troubles.
3. They show you how to reconnect motors to meet any condition of voltage, phase, frequency and speed.
4. They give you suggestions for preventing electrical machinery troubles.
5. They cover fully the rewinding of motors.
6. They present information that will help you get better service out of your electrical equipment.
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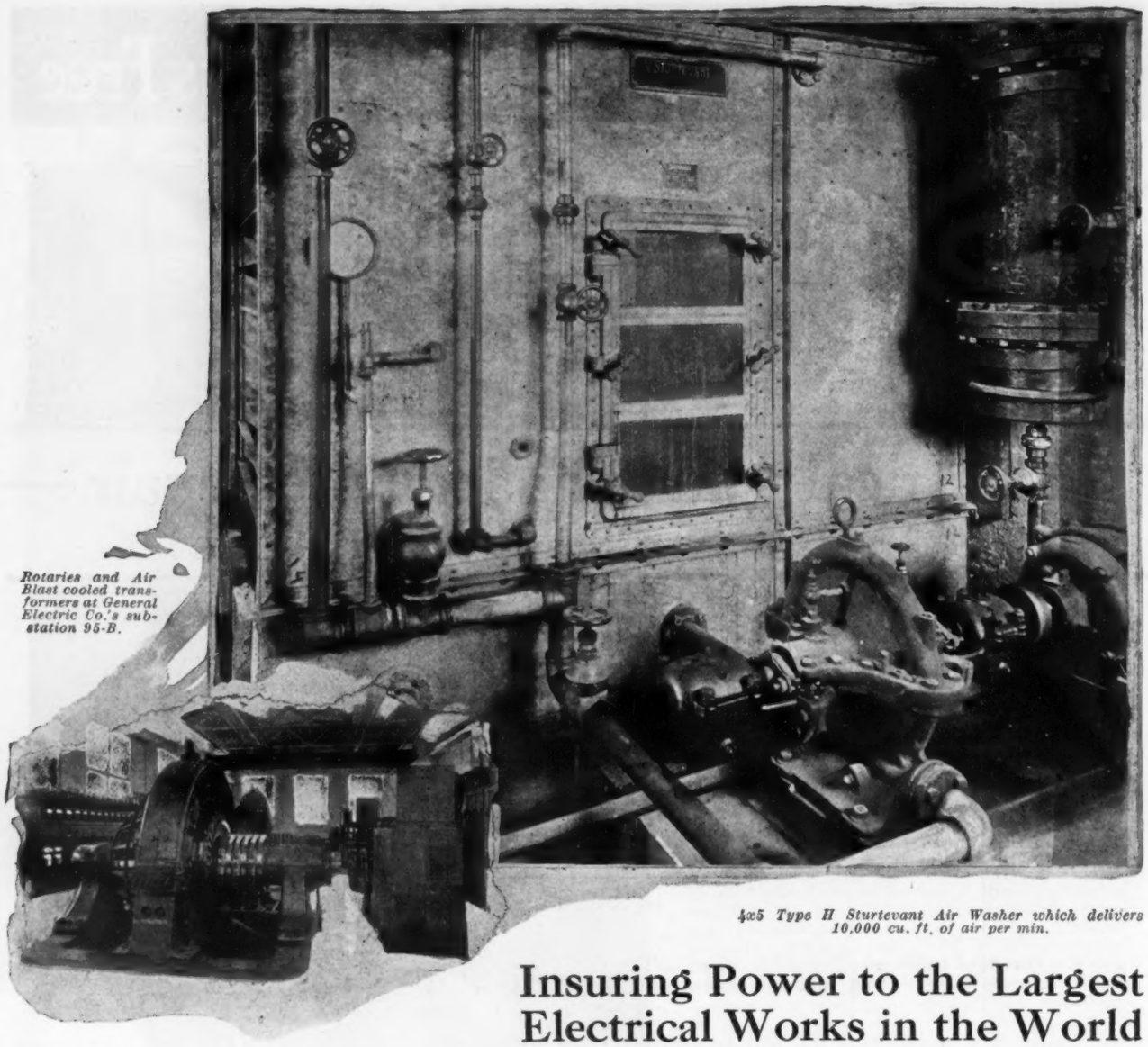

Rotaries and Air Blast cooled transformers at General Electric Co.'s substation 95-B.

4x5 Type H Sturtevant Air Washer which delivers 10,000 cu. ft. of air per min.

Insuring Power to the Largest Electrical Works in the World

THIS Sturtevant equipment—at the General Electric Company's substation No. 95B—helps to provide a continuous power output for the Schenectady works—the largest electrical manufacturing plant in the world.

In this substation, as in numerous others the world over, Sturtevant Air Washers furnish air for generator cooling and for the air blast cooled transformers.

Sturtevant was the Pioneer in Ventilating Equipment. It logically follows, therefore, that these important builders of electrical equipment should specify apparatus built by the largest manufacturers of Fans, Fan Systems and allied products. All Sturtevant Air Washers have a guaranteed cleaning efficiency of 98%.

If you have a ventilation problem, consult with the nearest Sturtevant representative.

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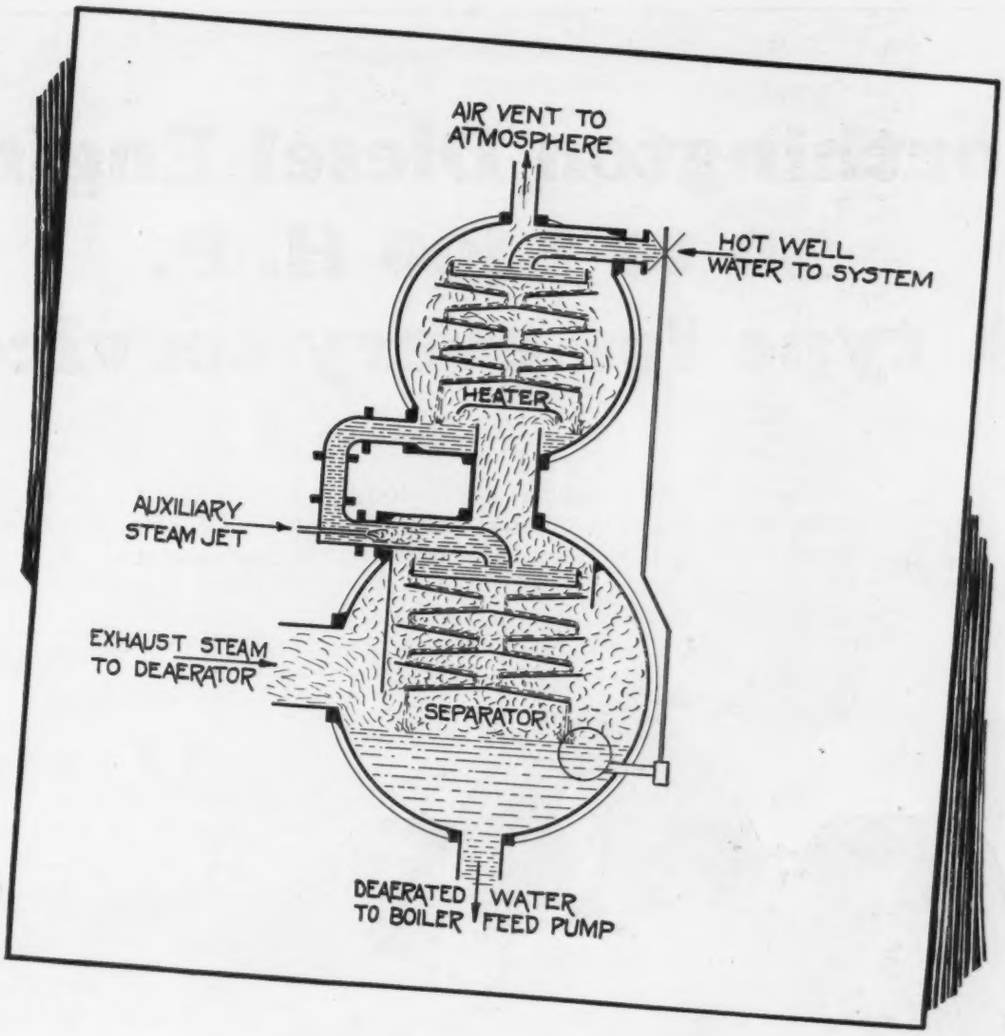

The New Type "M" Deaerator

It employs contact mixing of heating steam and water, utilizing two chambers in series, with the water and steam flow in counter-direction.

The upper chamber has the operating simplicity of an induction open feed water heater.

The lower chamber is devoted exclusively to the duty of deaeration.

The type "M" is a simplified Deaerator, which will deliver zero oxygen water at the temperature of the steam.

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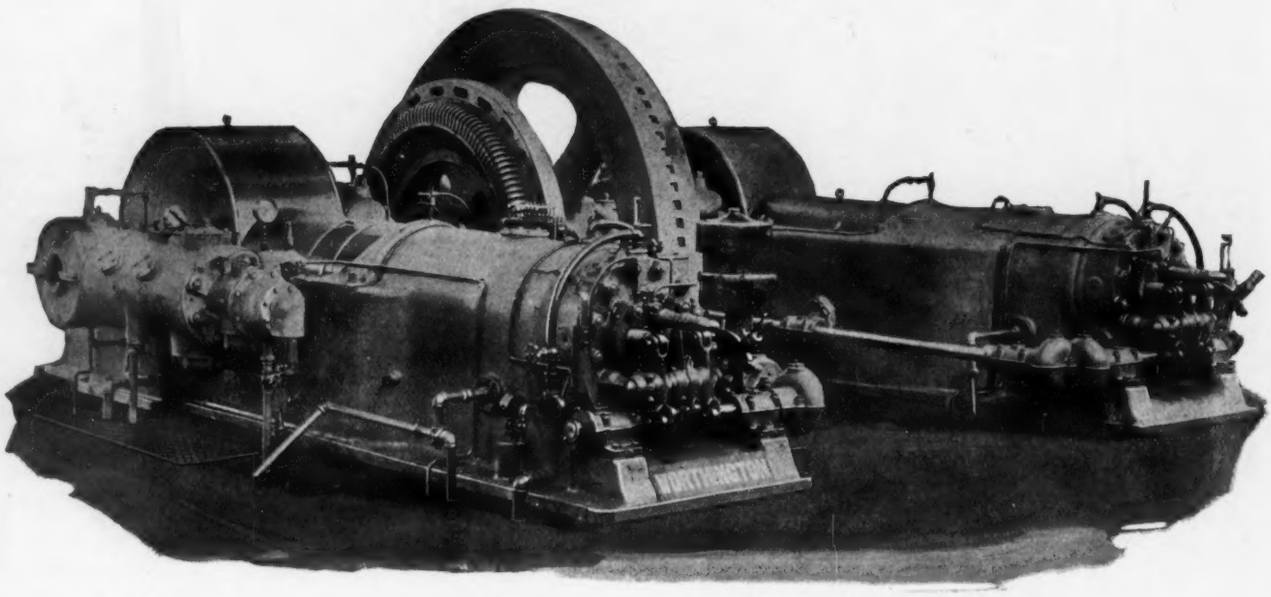
N-804

Elliott Deaerators Definitely Solve the Corrosion Problem in Power Plants

Worthington Diesel Engines
30 to 2400 H. P.
A type for every service

In the thirty years that Worthington has been making internal combustion engines an aggregate of 446,359 horsepower has been built. Worthington has now a range of patterns in sizes and types to meet the particular demands for every service.



The illustration shows a two-cylinder horizontal four-cycle air injection Diesel oil engine connected to an A. C. generator

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Executive Offices: 115 Broadway, New York City. Branch Offices in 24 Large Cities W-197.8

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Gas Engine Works, *Cudahy, Wis.*
Power & Mining Works *Cudahy, Wis.*
Snow-Holly Works *Buffalo, N. Y.*
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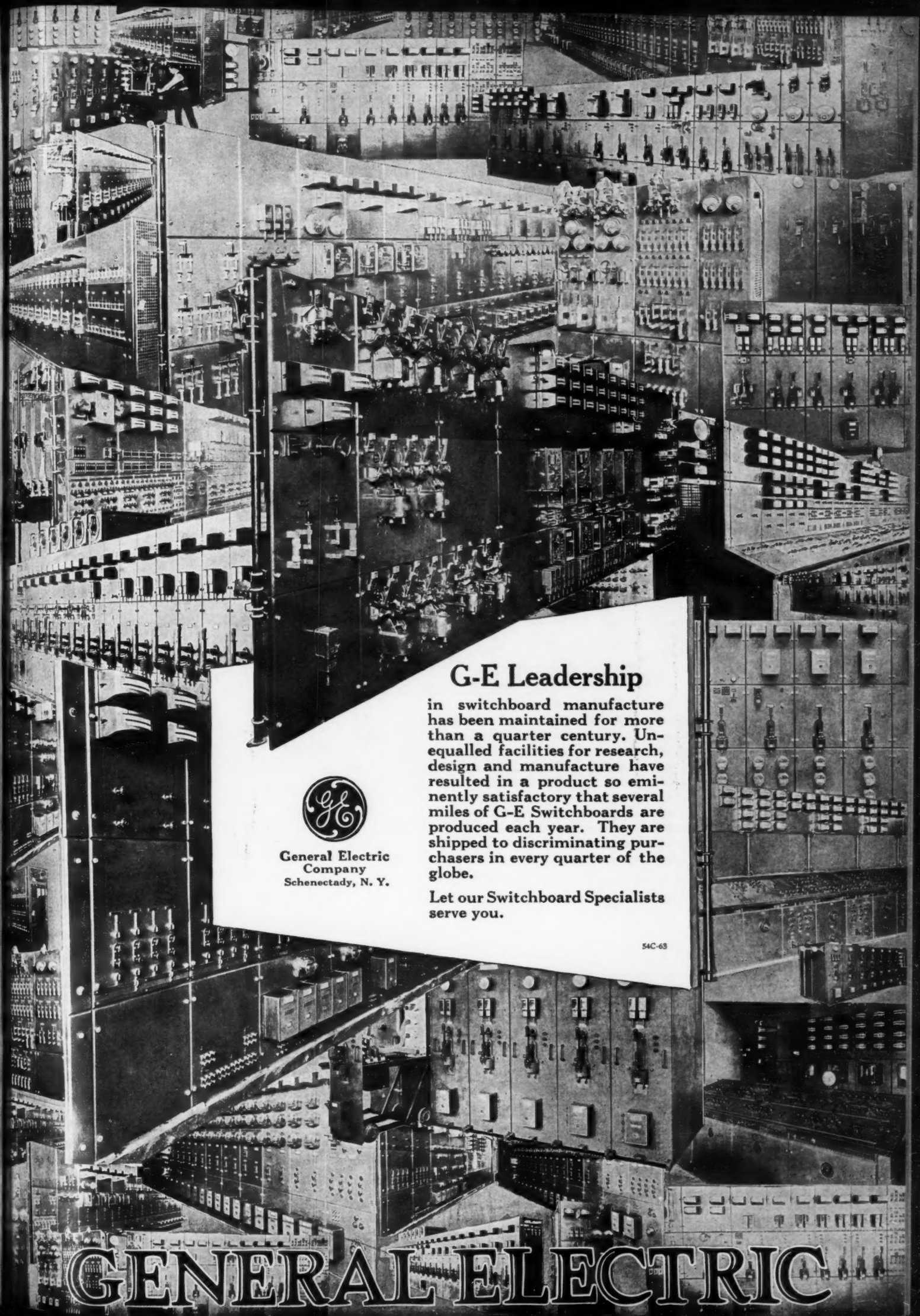
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in switchboard manufacture has been maintained for more than a quarter century. Unequalled facilities for research, design and manufacture have resulted in a product so eminently satisfactory that several miles of G-E Switchboards are produced each year. They are shipped to discriminating purchasers in every quarter of the globe.
Let our Switchboard Specialists serve you.
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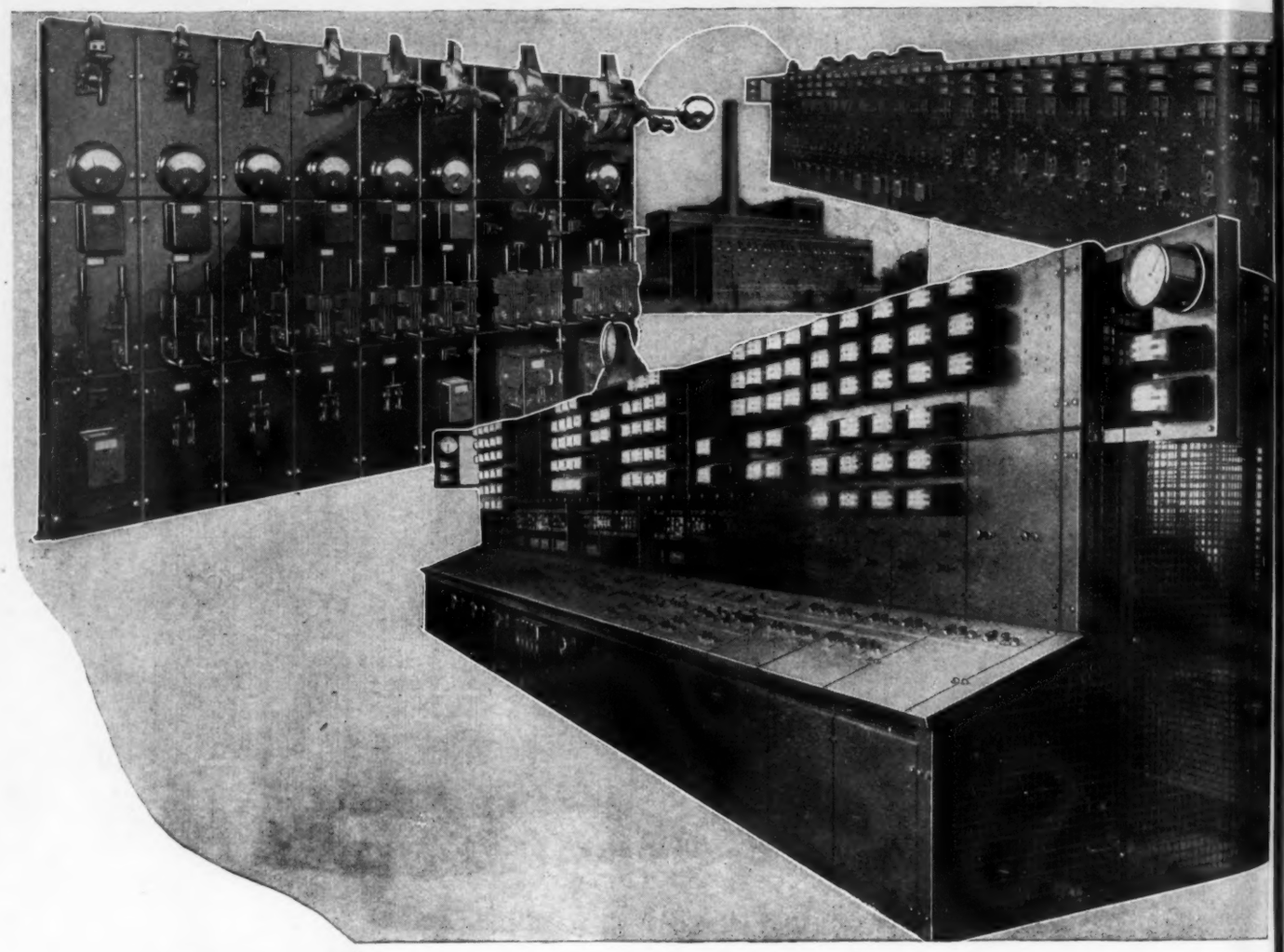
General Electric Company
Schenectady, N. Y.
GENERAL ELECTRIC



Switchboards for Large and

Switches and Circuit Breakers

on G-E Switchboards will meet the operating conditions. G-E Lever Switches are made of the best obtainable materials, are liberally designed, and conservatively rated. G-E Air Circuit Breakers are simple, safe, and reliable. And G-E experience with Oil Circuit Breakers extends to the largest units in the world.

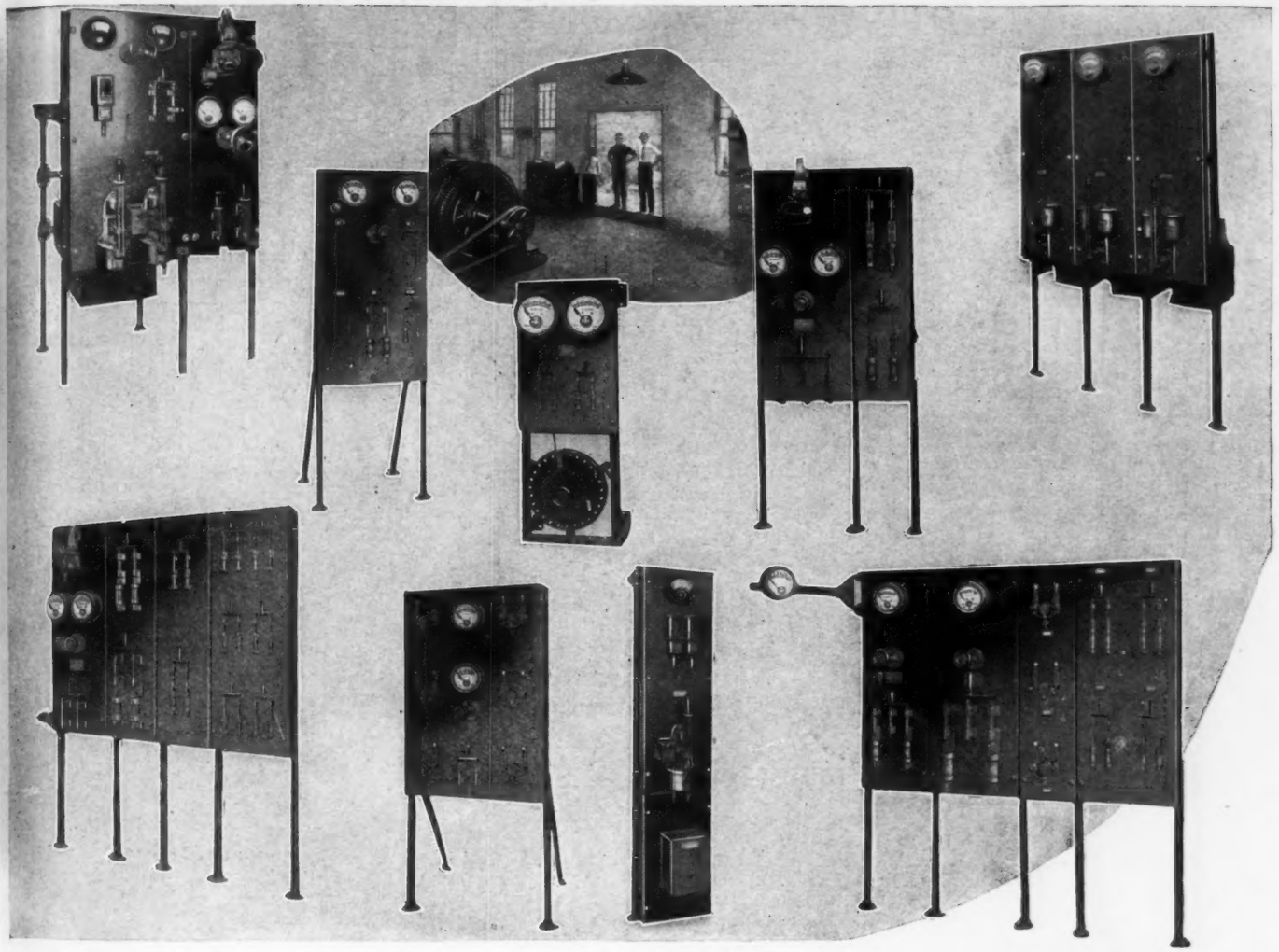
General Electric Company
Schenectady, N. Y.

The switchboard with its accessories has rapidly progressed to a position of great importance. It requires as much consideration as any apparatus in the power station.

The General Electric Company has furnished switchboards for controlling the highest commercial voltages, each board fully equipped with metering, switching and protective devices, also of G-E design and manufacture.

In consequence of this vast experience, backed by unparalleled facilities, engineers are turning more and more to "GE" on problems involving the largest interconnected systems in existence.

GENERAL



for Isolated Stations

In many small plants and central stations it is of prime importance to hold initial investment as low as possible in keeping with good service.

For this the General Electric Company offers a complete line of switchboards in capacities from 1 kw. up. These panels have complete supporting framework with necessary fittings and are fully equipped. The smallest panels are arranged for wall mounting.

Even for small plants you are spared the work of writing switchboard specifications, as it is possible to make your selections from G-E Switchboards, which have the advantages of quantity production and uniform design.

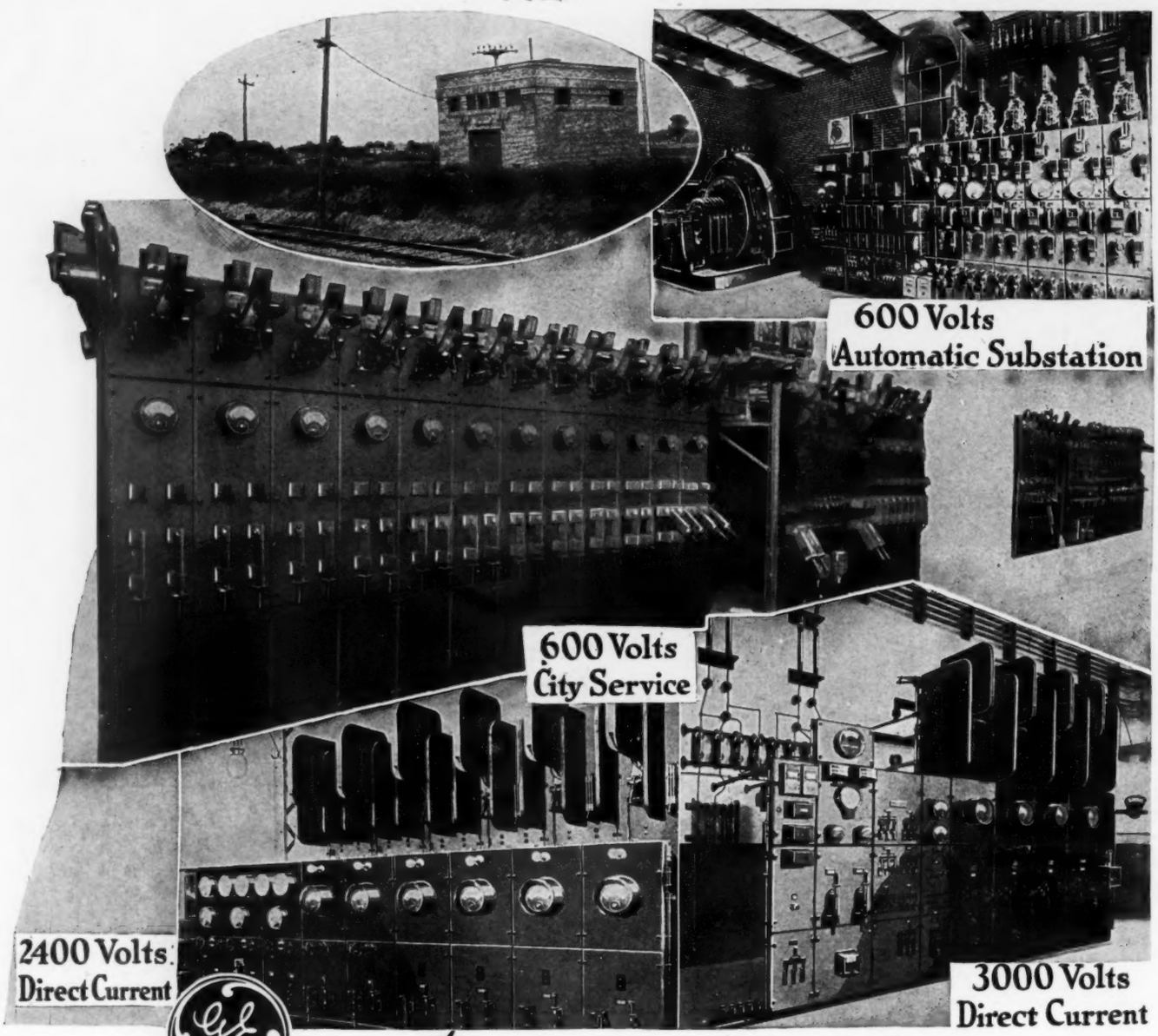
Accessories and Connections

are such that the construction back of the board is particularly neat, accessible and lasting. Framework, fittings, supports, switch pedestals, etc., for making extensions are available in great variety. Joints in the copper connections are kept at a minimum by various bends and offsets given to the bars by special hydraulic presses of G-E design.

General Electric Company
Sales Offices in all Large Cities

54C-90

ELECTRIC



Switchboards for Railways

Meters and Instruments

furnished on G-E Switchboards are built to rigorous standards. They possess all known design features essential to high initial and sustained accuracy, effectual damping and service durability.

G-E Switchboards provide for the control of any or all of the machines and circuits used to furnish power to electric railway and electrified railroad systems. D-C. or A-C. Switchboards for any voltage or capacity used in this service are available for either automatic or manually-operated stations.

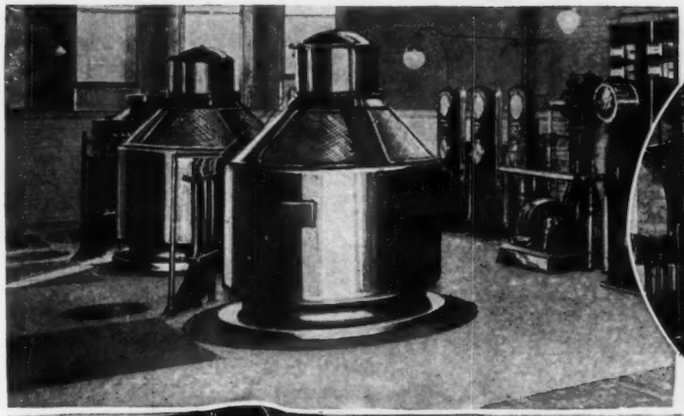
The Air Circuit Breakers for high-voltage d-c. panels are equipped with a special arc chute and magnetic blowout.

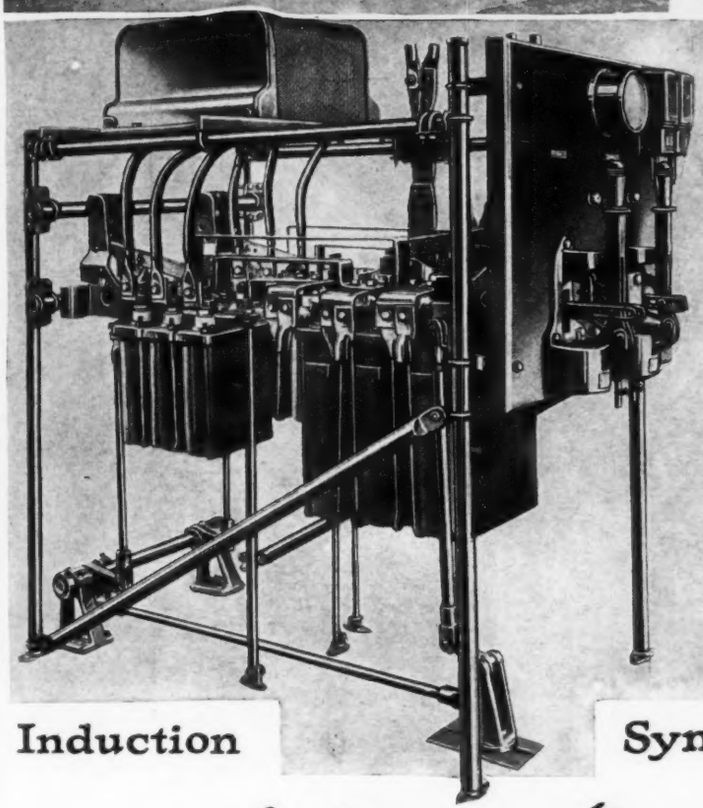
Panels are set up in the factory and before shipment are completely wired and equipped.

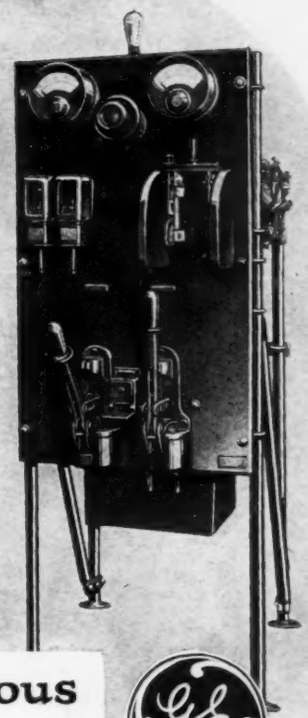
G-E Switchboards for motor control are designed primarily for use with standard G-E Synchronous and Induction Motors and motors of other manufacture having similar characteristics.

General Electric Company
Schenectady, N. Y.

GENERAL







Induction **Synchronous**

and for Motor Circuits

Very important features of these panels are the interlocks which insure proper sequence of operation. These prevent closing the running side of breaker until the starting side has first been closed and then opened. The running side can be closed only within a predetermined period after opening the starting side.

The panels for controlling synchronous motors driving pumps, compressors and similar machinery provide for connecting the motor to the line through the compensator at starting, as well as for control of the motor when under load. Every design includes a compact oil circuit breaker which has been found most satisfactory in the many G-E installations.

Methods

provide that devices, small wiring and other parts, are assembled at the factory. The switchboard is inspected by men specially trained; then it must meet the approval of the engineer in charge. This insures you a complete switchboard and the elimination of unexpected expense or delay during installation.

General Electric Company
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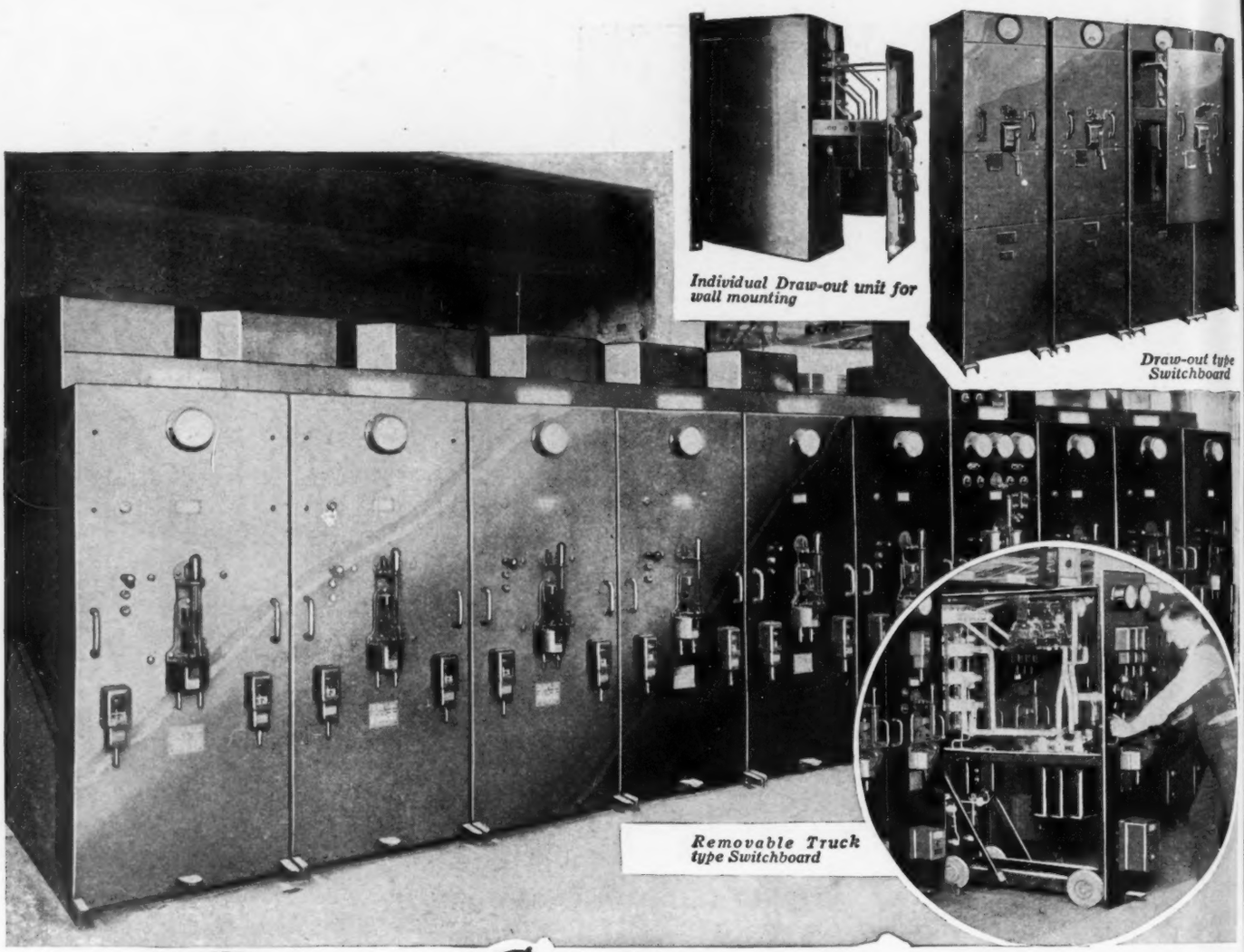
ELECTRIC



Individual Draw-out unit for wall mounting

Draw-out type Switchboard

Removable Truck type Switchboard

Safety Enclosed

Design

is the combined result of research and experience. All G-E Panels are developed with special reference to the service required. Each device is designed by specialists, so that with every G-E Switchboard you receive the service of highly-trained switchboard engineers.

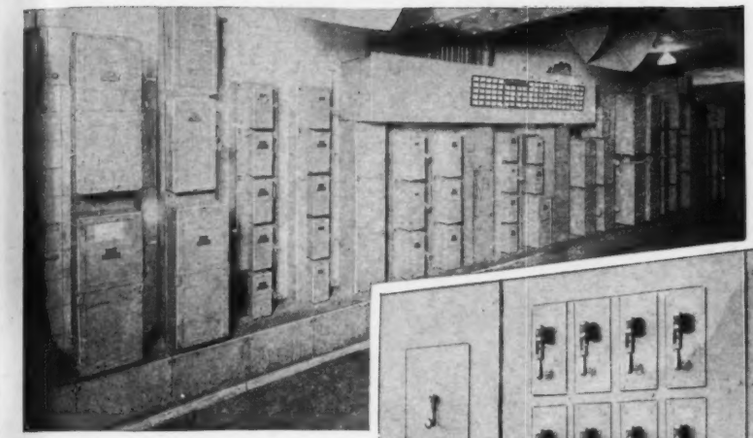
General Electric Company
Schenectady, N. Y.

Continuity of service is an asset dependent largely on the Switchboard. Safety Enclosed Switchboards help insure it. Hence, the increasing demand for G-E Safety Switchboards by public utilities, industrial plants, and commercial buildings.

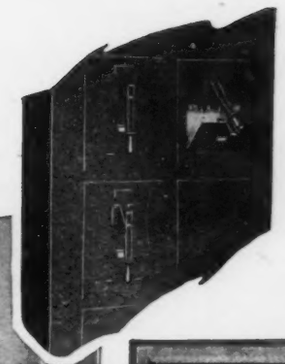
With a *G-E Removable Truck Switchboard,* for instance, you simply withdraw a unit for inspection or repair, and push a spare into the place of the unit withdrawn. Then, with service restored, the withdrawn unit can be examined or worked on remote from live circuits.

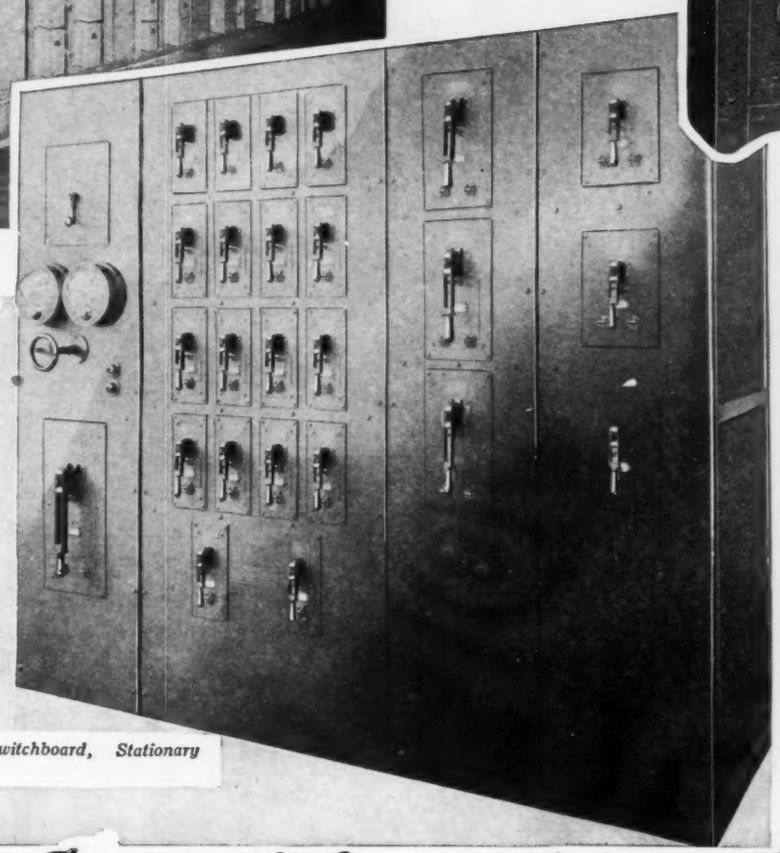
One of the most important features of this type of board is its ease and economy of installation. Practically all the assembly work is done in the factory. You need only bolt the housing to the floor and to the adjacent housing, slide busbars into clamps, connect the cables and fill circuit breaker tanks with oil. (Bulletin 67100)

GENERAL

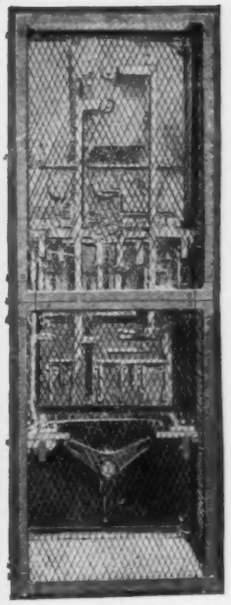


Flexible Distribution Switchboard Panels. (By permission New York Stock Exchange Building Co.)





Enclosed Switchboard, Stationary type



Showing grill enclosure as used on G-E Enclosed Stationary Switchboards

Unit Switchboards

Dead-front Stationary Panels have no live parts exposed; their switches can be locked open, and the fuse chamber is accessible only when the switch is open. (Bulletin 67110)

In the *Draw-out Safety Panels* the breaker can be connected or disconnected simply by moving the unit in or out. Like the Enclosed Truck and Dead-front Stationary Panels, they can be used singly or assembled as a complete switchboard. (Bulletin 67105)

Enclosed Sectional Distribution Switchboards consist of metal wiring units, which can be mounted on any standard surface or on a simple skeleton framework, the foundation of the group being a horizontal bus unit or series of units mounted end to end. (Bulletin 67115)

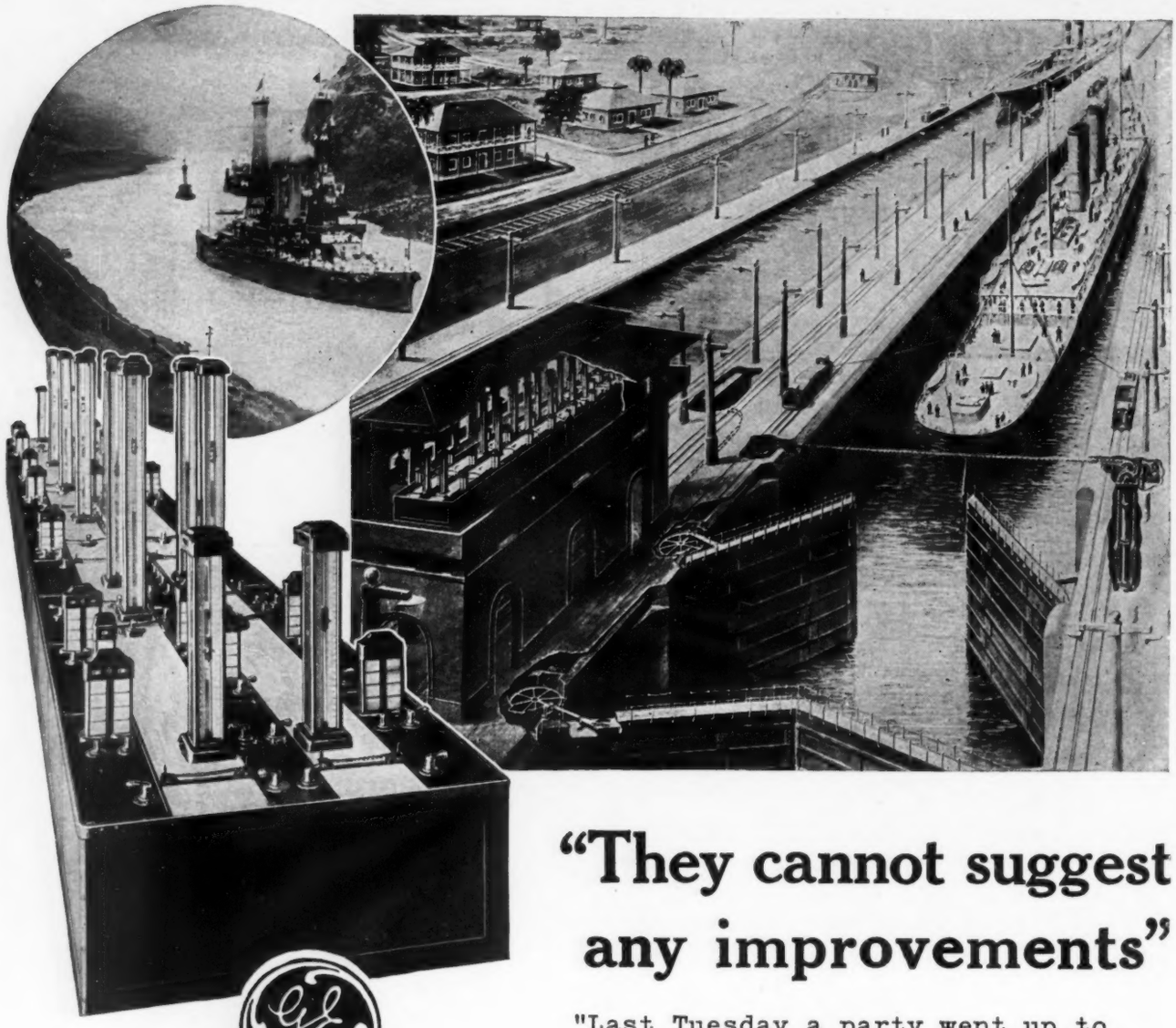
Responsibility

for the performance of G-E Switchboards is undivided. Every Board is designed, built, and assembled by a single organization. The devices are products of G-E factories. You can be sure they are consistent with the duty the switchboard is expected to perform.

General Electric Company
Sales Offices in all Large Cities

54C-91

ELECTRIC



"They cannot suggest any improvements"

"Last Tuesday a party went up to Miraflores Lock and went out over it. I got a chance to inspect it thoroughly, and talked to the men running it, and keeping it up. Everything is working to the very top of perfection, and is in practically all respects exactly as we built it. They cannot suggest any changes or improvements, and it works all the time. The total shutdown is only a matter of a few hours in the year when the Locks are out of water for cleaning or repairs. I shall try to examine the Pedro..."

From report of inspecting engineer

Quality

The Panama lock control boards, built by the General Electric Company nearly 10 years ago, have always operated highly satisfactorily. There could be no better proofs of G-E Switchboard quality, nor a better example of the Company's ability to build Switchboards for special applications.

General Electric Company
Schenectady, N. Y.

GENERAL ELECTRIC

54C-94

What Market Possibilities Does the West Offer You for 1924?

To be published February 1, 1924

Western Progress and Superpower Issue

The electrical growth of the West will again exceed estimates and prophecies for 1923, thus maintaining the records for the previous two years.

The Expanding superpower system of the Coast States, the greatest in the world today; New central station developments; Increasing industrial uses of current; Additional thousands of wired homes with their tens of thousands of new appliances—these are the factors that combine to make a phenomenal story of electrical growth that will be told in the February 1st, 1924, issue of the Journal of Electricity.

Conditions revealed by the charts, diagrams, and statistics will be vital factors in determining the 1924 policies of central stations, jobbers, retailers, and manufacturers.

Superpower and the Pacific Coast, by Frank G. Baum

A discussion of western power resources and power markets and suggestions for the superpower system that will best utilize the available power. As consulting engineer for the Pacific Gas and Electric Company and author of the "Atlas of U. S. A. Power Systems," Mr. Baum is the outstanding national authority on superpower.

Analysis of Western Superpower System

A discussion of the present superpower system of the Coast States with tables and map showing capacities, voltages, mileage of wire, output, etc., with recent interconnections and interconnections planned.

Analysis of 1923 Electrical Growth

An article with charts showing the various units added, undertaken, and projected during the past year with detailed analysis and comparative figures of preceding periods.

The Market for Electric Appliances

An analysis and large, 3-color map (21 x 28) of the eleven western states showing population centers, number of homes, number of wired homes, residential consumers and loads, increases for 1923 and estimated increases for 1924.

You can easily visualize the interest with which this issue will be received by the key men in every branch of the electrical industry. Telling your sales story, and telling it BIG will give the right kind of send-off to your 1924 business.

Reserve space now. Send your copy later; or let us help you in preparing your copy. Be sure you are in this important issue!

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3-phase 60-cycle Generators Revolving Field

Kva.		Speed
1 30	Roth, 220-volt, single phase	1800
1 50	Westinghouse, type G, 2300-volt	1200
50	Lincoln, 220 or 440-volt	1200
1 55	Westinghouse, 2200-volt to McEwen steam engine	257
1 60	Triumph, 2400-volt	720
3 60	G.E., ATB, 220 or 440-v	1200
1 62½	Westinghouse, revolving field, type G, 2300-volt	1200
1 70	Westghse., 2400-volt to Harrisburg - Fleming steam engine	300
75	G. E., ATB, Form PB, 220- or 440-volt	1200
1 75	Westghse., 2300-volt to Ball steam engine	300
1 75	Crocker-Wheeler, 2300-volt, McEwen horizontal, center crank, self-oiling auto. steam engine	275
1 80	Allis-Chalmers, 2300-v.	900
1 100	G. E., type ATB, form P, 2300-volt	900
1 112½	G. E., type TRC, revolving field, 220- or 440-volt	1200
1 120	Westghse., type G, 2300-volt	900
1 150	Crocker-Wheeler, 2300-volt, to Harrisburg-Fleming, 4-valve engine	257
1 200	Westghse., type G, 240- or 480-volt	600
1 200	G. E., ATB, form P, 2300-volt	600
1 225	G. E., ATB, form PB, 220- or 440-volt	600
1 312	Ft. Wayne, TRB, 2300-volt	450
1 625	Westinghouse, revolving field, 2300-volt, 3-phase turbo-generator, direct-connected to Westinghouse-Parsons, horizontal, 3-stage, steam turbine, complete with jet condenser.	

Single-phase 25-cycle Motors

Hp.		Speed
1 5	Century, RS, repulsion	1460
1 7½	Century, type RS	1460
1 10	Century, type RS	1460
1 7½	Watson, type SH	1450
1 10	Wagner, type BA	720
1 15	Wagner, type BA	1440
1 15	Wagner, type BA	720

2 phase 60 cycle

Hp.		Speed
4 1	G. E., type KQ	1800
1 1	Westghse., type CSA	1725
2 1	G. E., type KQ	1200
8 1	Howell	900
1 1½	G. E., type KQ	1200
1 1½	Century, AS (wound rotor)	1145
1 2	Howell	1800
3 2	G. E., type KQ	1800
1 2	Westghse., type CCL	1700
3 2	G. E., type KQ	1200
1 3	G. E., type KQ	1800
2 3	Holtzer-Cabot	1200
1 3	G. E., type KQ	1200
1 5	Fairbanks-Morse, B	1800
1 5	Diehl	1710
1 5	Westghse., type CCL	1700
12 5	G. E., type KQ-732	1200
6 5	G. E., type KQ	900
1 5	Westghse., type CCL	850
1 6	Burke	1200
1 7½	G. E., type KQ	1800
6 7½	G. E., type KQ	400-1200
1 7½	G. E., type MQ, slip-ring, variable speed	1200
1 7½	Fairbanks-Morse	900
6 7½	G. E., type KQ	900
1 10	Westinghouse, type CS	1750
2 10	G. E., type KQ	1200
1 10	Fbks-Morse, type BV, slip-ring, variable speed	1200
1 15	Fairbanks-Morse	1800
1 15	G. E., type I, form M, new, slip-ring	1200
1 15	Westghse., type HF, slip-ring, variable speed	1150
1 20	G. E., type KQ	3600
1 20	G. E., type KQ	1800
1 20	G. E., type KQ	1200
1 30	Westghse., type CS	570

3-ph. 25-cy. A.C. Motors

Hp.		Speed
1 3	G.E., type KT	1500
1 3	Howell, type SC	1500
1 3	G.E., type KT	750
2 5	G.E., type KT	1440
1 5	Fairbanks-Morse	750
2 7½	G.E., type KT	1500
1 7½	Watson, type KH	720
1 10	Wagner, BW	750
2 10	G. E., type KT	750
1 15	St. Louis	1500
1 15	Howell, type SC	750
1 15	G. E., type KT	750
2 15	Fbks.-Morse	750
1 20	Howell, type SC	1500
2 20	Fbks.-Morse	750
1 25	G. E., form K	750
2 30	Fbks.-Morse	750
1 35	Howell, type SC	1500
2 40	G. E. type KT	750
1 40	Westghse., CS	730
2 50	Allis-Chal., type AN	750
1 50	Fbks.-Morse, type B	750
4 50	G. E., form K	750
1 50	Westghse., type MW, slip-ring	720
1 60	Allis-Chal., type AN	720

3-ph. 25-cy. A.C. Motors —Continued

Hp.		Speed
1 100	Wagner, slip-ring	710
1 150	Allis-Chal., slip-ring	750
1 300	Allis-Chalmers, slip-ring	485

3-ph. 60-cy. A.C. Motors

Hp.		Speed
1	¾ G. E., type KT	1800
8	1 G. E., type KT	1800
1	1 Fairbanks-Morse B	1800
4	1 Howell, SC	1800
2	1 Peerless	1750
3	1 G. E.,type KT	1200
1	1 G. E., type MQ, sl.-rg.	1200
4	1 Watson type KH, 550v.	550
1	1½ G. E. type KT	1800
1	1½ Wagner, type BP	1750
1	1½ Lincoln	1200
1	1½ G. E., type KT	1200
1	1½ Watson, type KH	1140
3	2 G. E., type KT	1800
4	2 Howell, SC	1800
3	2 Supreme, type MO	1800
1	2 Century, AS (wound rotor)	1750
1	2 Allis-Chal., type AN	1750
5	2 G. E., type KT	1200
1	3 Wagner, type BP	3400
1	3 G. E., type KT	1800
2	3 Supreme, type MO	1800
3	3 Howell, SC	1800
1	3 Wagner, type BW	1725
1	3 G. E., type KT	1200
1	3 Burke, type B	1200
1	3 Howel, SC	1200
1	3 Westghse, type CW, slip-ring	850
1	5 Lincoln	1800
7	5 G.E., type KT	1800
6	5 Howell, SC	1800
3	5 Supreme, MO	1800
1	5 Watson, type KH	1750
2	5 Allis-Chal. type AN	1750
4	5 G. E., type RT	1200
3	5 Supreme, type MO	1200
7	5 Howell, SC	1200
2	5 Crocker-Wheeler	1140
1	5 Watson, type KH, slip-ring	1140
1	5 Westghse, type CS, for elevator service	720
5	7½ G. E., type KT	1800
1	7½ Fbks.-Morse, type B	1800
3	7½ G. E., type KT	1800
1	7½ Watson, type KH, sl.-rg.	1720
2	7½ G. E. type KT	1200
1	7½ Burke	1200
10	7½ Westghse., type CS	1130
1	7½ G. E., type KT	900
4	10 G. E., type KT	1800
1	10 G. E., type MT, sl.-rg.	1800
1	10 Allis-Chal., type AN	1750
1	10 Westghse., type CW, slip-ring	1700
2	10 G. E., type KT	1200
5	10 Allis-Chal., type AN	1160
1	10 Allis-Chal., type ANY, slip-ring	1160
1	10 G. E., type KT	900

3 phase 60 cycle Motors

Hp.		Speed
1	15 Allis-Chal., type AN	1750
4	15 G. E., type KT	1200
2	15 G. E., type I, form M, slip-ring	1200
5	15 Allis-Chal, type AN	1150
1	15 Westghse., type HF, slip ring	1150
4	15 G. E., type KT	900
5	15 Allis-Chal., type AN	850
1	15 G. E., type I, form K 4 speed	1800-1200-900-600
1	20 G. E., type KT	1200
1	20 Westghse., type CX	1120
1	25 G. E., form K	900
1	25 Westinghouse, CS	865
2	25 Crocker-Wheeler	850
2	30 G. E., type KT	900
1	30 Allis-Chal., type AN	850
4	30 Allis-Chal., type AN	575
1	35 Westinghouse, CS	870
1	40 G. E., type KT, 2200-v.	1800
1	40 Westghse., type CS, direct connected to Worthington centrifugal pump, (capacity 500 gal. per min.)	1750
1	40 Crocker-Wheeler	850
5	40 Allis-Chal., type AN	850
1	40 Westghse, type CS	695
1	40 G. E., type KT	600
1	50 Fbks-Morse, type B	900
1	50 G. E., form M, slip-ring	900
2	50 Westghse., type CS	870
2	50 Allis-Chal., type AN, 2200 volt	865
2	50 Allis-Chal., type AN	850
1	50 Westghse., type F, slip-ring	850
1	60 Westghse., type MW, slip-ring	680
1	75 G E., form K, 2300-v	1800
1	75 Allis-Chal., type AN	865
1	75 G. E., type I, form M, slip-ring	720
1	75 Fairbanks-Morse, sl.-rg.	690
1	100 G. E., form K	1800
1	100 Allis-Chal., ANY, slip ring	870
1	100 G. E., type I, form M, slip-ring	720
2	100 Westinghouse, CS	580
1	125 Fairbanks-Morse	900
1	150 Westghse., type G, revolving field, 2300-v., synchronous motor	900
1	150 G. E., type I, form M, 2200-v., sl.-ring	600
1	150 Westghse., type CCL, 2200-v	450
2	200 Westghse., type CW, slip-ring	580
1	250 Westghse., type G, rev. field, 440-v. synchronous motor	600

VERTICAL MOTORS, 3-PH., 60-CY
220 or 440 Volts

Hp.		Speed
3	75 Allis-Chal All complete	514
3	75 Allis-Chal. complete	490

TELL US YOUR REQUIREMENTS

MOTORS, GENERATORS, METERS, TRANSFORMERS

We Buy, Sell, Repair, Rent and Exchange

GREGORY REBUILT

motors and generators have been overhauled—and inside-outer-hauled—**the Gregory way**—THEY HAVE BEEN completely taken apart, each part carefully examined and tested, every defect corrected, including replacement, where necessary; then completely re-assembled, refinished and carefully tested with load, under expert supervision, and turned out in appearance and for service, practically equal to new.

TIFFANY ELECTRIC COMPANY INC
POWER EQUIPMENT ENGINEERS
OFFICE AND FACTORY 131-143 HOWELL ST. JERSEY CITY, N.J.

Telephone
Cortlandt 4204 (New York)
Bergen 7450 (Jersey City)

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MOTORS—GENERATORS

Immediate Shipment

MOTOR-GENERATOR SETS

(Each complete with starter, rheostat, etc.)

Gen. 750-kw., 514-r.p.m., 250-volt, Westinghouse compound wound interpole on same shaft and base with
Motor, 1080-hp., 2300 or 440-volt, 514-r.p.m., synchronous self-starting revolving field complete.

Gen. 300-kw., 720-r.p.m., 250-volt, Westinghouse interpole compound wound, on same cast iron base and direct connected with
Motor, 450-hp., 2300-volt, 720-r.p.m., 3-ph., 60-cycle, synchronous, self-starting, revolving field with starting apparatus.

Gen. 200-kw., 125-volt, 1200 r.p.m., General Electric Interpole type MPL form L on same base and direct connected with
Motor, 2200-volt, 1200-r.p.m., 300-hp., 3-ph., 60-cycle General Electric ATI synchronous complete with starting apparatus.

Gen. 140-kw. (2—70-kw. generators), 125/250-volt, 700-r.p.m., compound wound, direct connected to
Motor, 200-hp., 2300-volt, 700-r.p.m., 3-phase, 60-cycle Crocker-Wheeler.

Gen. 100-kw., 125-250-volt, 720-r.p.m. Westinghouse, 3-wire.
Motor, 140-kva., 2200-volt (or 440-volt), 720-r.p.m., synchronous, Westinghouse.

Gen. 50-kw., 250-v., 1200-r.p.m., compound wound Crocker-Wheeler, on same base with
Motor, 75-hp., 2200-v., 1200-r.p.m., 3-ph., 60-cy. Crocker-Wheeler (set never used).

The above is a partial list; quotations covering other machines upon request.

ROTARY CONVERTERS

Stock No. 1859. One (practically new) 500-kw., 250-v., 720-r.p.m., compound wound, interpole, 10-pole G. E. type HCC, with three 175-kva., 2300-v. or 13200-v. primary, 190-v. secondary, single phase, 60-cycle oil insulated transformers, also switchboard apparatus.

Stock No. 1414. One practically new, 300-kw., 250-v., 1200-r.p.m., 3-ph., 60-cy. Allis-Chalmers interpole, complete with field rheostat, end play and speed limit devices, also with three 125 kva., 13,200-v. primary (also 2300-v. primary), single phase, 60-cy. transformers and A.C. and D.C. switchboard panels.

Stock No. 1853. 200-kw., 250-v., 800-amp., 1200-r.p.m., 3-ph., 60-cy., Westinghouse Rotary Converter, complete with switchboard and three 75-kva., 2300-v. or 4100-v. primary, and 153-v. secondary, single phase 60-cy. Transformers, also with motor operated field rheostat and accessories.

60-CYCLE MOTORS

Stock No.	*Hp.*	*Volts*	*Speed*	*Phase*	*Description*
S-1852	400	2300	514	3	Westinghouse slip ring, 3 bear.
1823	300	2300	600	3	Gen. Elec. Type ATI synchron.
1404	235	2200	720	3	Gen. Elec. Type ATI synchron.
1847	200	2200	600	3	Gen. Elec. Type I, form M sl. rg.
1420	150	220/440	1200	2	Electric Machinery synchron.
1486	100	2200	720	3	Westinghouse HF slip ring
1814	50	220/440	1200	3	General Electric slip ring
S-1851	50	440/220	860	3	Al.-Chal., slip ring
1018	40	220	1200	2	Westinghouse CS squirrel cage
1410	40	2200	900	3	General Electric K squirrel cage
S-1827	40	440/220	720	3	Gen. Elec. Form KT. sq. cg.
1596	30	440/220	600	3	General Electric K squirrel cage
1806	30	440/220	860	3	Westinghouse CS squirrel cage
1792 to (14)					
1805	25	440/220	865	3	Westinghouse CS squirrel cage
1593	25	220/440	900	3	General Electric K squirrel cage
1592	25	220/440	900	3	General Electric K squirrel cage
1582	20	220/440	900	3	General Electric K squirrel cage
953	20	440/220	900	3	Westinghouse CS squirrel cage
849	20	440/220	1200	3	General Electric M slip ring
1789	20	440/220	720	3	Westinghouse CS squirrel cage
1788	20	440/220	720	3	General Electric KT squirrel cg.
1785	20	440/220	860	3	Westinghouse CS squirrel cage
1786	20	440/220	860	3	Westinghouse CS squirrel cage
1787	20	440/220	860	3	Westinghouse CS squirrel cage
1784	20	220/440	900	3	General Electric KT squirrel cg.
1783	20	440/220	690	3	Westinghouse CW slip ring
1781	15	440/220	850	3	Westinghouse CW slip ring
1782	15	440/220	850	3	Westinghouse CW slip ring
1776	15	440/220	850	3	Westinghouse CW slip ring
1774	15	440/220	850	3	Westinghouse CW slip ring
1766	15	440/220	850	3	General Electric MT slip ring
1762	15	440/220	850	3	General Electric MT slip ring
1777	15	440/220	860	3	Westinghouse CS squirrel cage

60-CYCLE MOTORS—*Continued*

Stock No.	*Hp.*	*Volts*	*Speed*	*Phase*	*Description*
1775	15	440/220	860	3	Westinghouse CS squirrel cage
1771	15	440/220	860	3	Westinghouse CS squirrel cage
1769	15	440/220	860	3	Westinghouse CS squirrel cage
1767	15	440/220	860	3	Westinghouse CS squirrel cage
1768	15	440/220	900	3	General Electric KT squirrel cg.
1758	15	440/220	900	3	General Electric KT squirrel cg.
1753	10	440/220	860	3	Westinghouse CS squirrel cage
1754	10	440/220	860	3	Westinghouse CS squirrel cage
1755	10	440/220	860	3	Westinghouse CS squirrel cage
1744	10	440/220	860	3	Westinghouse CS squirrel cage
1745	10	440/220	860	3	Westinghouse CS squirrel cage
1746	10	440/220	860	3	Westinghouse CS squirrel cage
1742	10	440/220	1150	3	Westinghouse CS squirrel cage
1750	10	440/220	900	3	General Electric MT slip ring.
1747	10	440/220	900	3	General Electric KT squirrel cg.
1748	10	440/220	900	3	General Electric KT squirrel cg.
1749	10	440/220	900	3	General Electric KT squirrel cg.

"Full stock of motors below 10 HP; quotations upon request."

FREQUENCY CHANGER SET

S-1843 Generator: 240-Kva. 300-r.p.m. 3-phase, 60-cycle (any voltage).
Motor: 335-Hp. 300-r.p.m. 3-phase, 25-cycle, synchronous (any voltage) with starting apparatus complete.

Note: The above set of General Electric manufacture, mounted on cast iron sub base. Immediate shipment.

25-CYCLE MOTORS

(Descriptions and quotations upon request.)

D. C. MOTORS

Stk. No.	*Hp.*	*Volts*	*Speed*	*Make and Type*
Cons.	150	230	550	Westg. "SK" interpole 3-brg.
S-1855	65	500	635	Westinghouse SA, interpole
S-1856	65	500	635	Westinghouse SA, interpole
S-1362	60	115	500	G.E.-Sprague, interpole
S-1572	50	500	600	Westinghouse SA interpole.
S-1573	50	500	600	Westinghouse SA interpole
S-1535	50	230	850	G. E.-Sprague.
S-1565	40	230	915	G. E., type CLB.
S-1560	20/40	115	300/1200	Cr.-Wh., intple., var. speed.
S-1818	20	115	525	G. E., type DLC, interpole.
952	35	500	650	G. E., "CLB"
1011	30	230	1200	G. E. (Spr.), "LC" interpole

The above is a partial list; quotations covering other machines upon request

D. C. GENERATORS

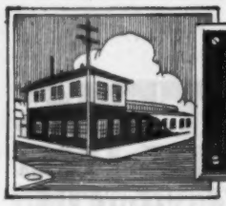
Stk. No.	*Kw.*	*Volt*	*Speed*	*Make and Type*
S-Cons.	400	230/250	400	Al.-Chal., interpole, 3-brg.
S-1609	175	250	500	G. E., type MP, compound wound.
S-Cons.	150	250	650	Westinghouse, interpole, compound wound
S-1812	90	250	750	G. E., type MP.
S-1570	65	250	725	Westinghouse, type SA, interpole.
S-1535A	40	250	950	G. E., Sprague, compound wound.

A. C. DIRECT CONNECTED UNIT

1—125-kva., 2300-volt (will reconnect for either 220 or 440-volt), 200-r.p.m. 3-phase, 60-cycle General Electric, Type ATB, revolving field Generator, direct connected to 16 in. x 18 in., side crank Erie City Simple Engine, with accessories.

A. C. BELTED GENERATORS

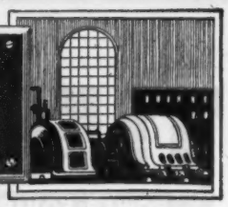
Stk. No.	*Kva.*	*Volt*	*Speed*	*Ph.*	*Cy.*	*Make and Type*
Cons.	375	2300	450	3	60	G. E. "ATB"
1404B	187½	2300	720	3	50	G. E., "ATB" complete



STEPHEN HALL & CO.

Incorporated

7th and Adams St's, Hoboken, N.J.



TELEPHONES: New York Direct Wire: Rector 3891; HOBOKEN 3750

New and Used Electrical Equipment—Condition Guaranteed—Ready to Ship

Slip Ring Motors—3-Phase, 60-Cycle

Hp.	Volts	Speed	Make	Type
225	440/220	514	General Electric	M
200	220/440	600	General Electric	M
200	2200	600	General Electric	M
150	2200	600	General Electric	M
150	220/440	600	General Electric	M
150	220/440	600	Crocker-Wheeler	Q
100	2200	720	General Electric	M
100	440/220	720	General Electric	M
100	440/220	900	General Electric	M
75	550	720	General Electric	M
75	2200	720	General Electric	M
75	220/440	720	General Electric	M
75	440/220	900	General Electric	M
75	440/220	1200	General Electric	MT
60	440/220	900	General Electric	M
50	550	900	General Electric	M
50	440/220	900	General Electric	M
50	2200	900	General Electric	M
35	220/440	720	General Electric	M
35	550	720	General Electric	M
35	440/220	900	General Electric	M
35	2200	900	General Electric	M

DIRECT CURRENT MOTORS

Hp.	Volts	Speed	Make	Type
175	115	525	Crocker-Wheeler	Interpole
125	115	500	Westinghouse	Interpole
100	220	625	Westinghouse	S
90	115	660	Crocker-Wheeler	D
75	115	400	Crocker-Wheeler	D
75	500	750	Westinghouse	M
50	115	750	Westinghouse	SK
50	550	565	Westinghouse	SK
50	220	525	Westinghouse	S
30	230	300	Westinghouse	M
30	110	575	Westinghouse	S
25	230	800	Westinghouse	S
20	110	600	Northwestern	K
20	230	925	General Electric	CQ
15	230	1250	Allis-Chalmers	Interpol

3-Phase, 25-Cycle Motors

200	440	500	General Electric, sl. rg.	
25	220/440	750	Burke sq. ca.	
15	220/440	750	Burke sq. ca.	

Squirrel Cage—3-Phase, 60-Cycle Motors

150	550	720	General Electric	K
150	220/440	720	General Electric	K
150	2200	720	General Electric	K
100	440/220	900	General Electric	K
100	440/220	720	General Electric	K
75	440/220	900	General Electric	K
50	440/220	1200	General Electric	K
50	440/220	900	General Electric	K
50	550	900	General Electric	K
50	220/440	900	Westinghouse	CS
40	220/440	900	Westinghouse	CS
35	220/440	720	General Electric	K
35	550	900	General Electric	K
35	220/440	900	General Electric	K
30	550	900	Westinghouse	CS
25	220/440	900	Westinghouse	CS
25	440/220	900	General Electric	KT
25	220/440	720	General Electric	K
25	440/220	1200	Westinghouse	CS
20	440/220	1200	General Electric	L
20	550	900	General Electric	KT
15	440/220	900	General Electric	KT
10	220/440	1200	Westinghouse	CCL

DIRECT CURRENT GENERATORS

Kw.	Volts	Speed	Make	Type
200	125	600	Crocker-Wheeler	Interpole
125	125	580	Westinghouse	Interpole
100	250	700	Westinghouse	S
75	250	850	General Electric	D
70	125	475	Crocker-Wheeler	D
55	125	855	General Electric	MP
50	250/125	1150	Westg. Interpole	SA
50	125	850	Westinghouse	SK
45	125	975	General Electric	CLB
40	250	875	General Electric	CLB
14	125	1425	General Electric	CVC
8	125	1700	General Electric	ML

MOTOR GENERATOR SETS

1—75-kw., 250 volt, 900-r.p.m. General Electric Sprague Type D Generator, direct connected to 115-hp., 220/440/550, 3-ph., 60-cy., Westinghouse synchronous motor.

1—50-kw., 250/125-volt, 1150-r.p.m., 3-wire; Westg. Interpole Generator coupled to 75-hp. 440/220-v., 3-ph., 60-cy. G. E. slip ring motor.

ALTERNATING CURRENT GENERATORS

1—225-kva. Westg. 220-volt, 514-r.p.m. 2- or 3-phase, 60-cycle, R. F. Gen. with belted exciter.

1—200-kw. Allis-Chalmers, 2300-volt, 600-r.p.m.; 3- or 2-phase, 60-cycle R. F. Generator, with direct connected Exciter.

1—100-kva. Westinghouse, 2300/480/240-volt; 900-r.p.m., 3-phase, 60-cycle, R. F. Generator; with belted exciter, complete.

1—112½-Kva., G. E., 2300/480/240-v., 1200-r.p.m., 3-ph., 60-cy., Type ATB Generator Complete.

1—60-kw., Westinghouse, 220-volt, 900-r.p.m., 2-ph., 60-cy. Gen. with belted exciter.

1—30-kw. Westinghouse 240/480-v., 1200 r.p.m., 3-ph., 60-cy. Generator, with belted exciter.

1—30-kva., General Electric 240/480-v., 1200-r.p.m., 3-ph., 60-cy., Type ATB, Form PB Generator with direct connected exciter, new

ENGINE GENERATOR SETS

1—80-kw., 250/125-volt, 3-wire Sprague G. E. D. C. Generator, connected to Ridgway 13x14 250-r.p.m. side crank engine.

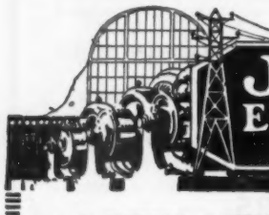
1—75-kva., 240-volt, 277-r.p.m., 60-cy., 2- or 3-ph. Westinghouse, A. C. Generator, direct connected to 12x14 Erie Ball, side crank engine with exciter and switchboard panel.

1—30-kw., 250-volt, 300-r.p.m. Gen. Elec., D. C. Generator dir. conn. to 10x10 Ames Engine.

TURBO GENERATOR SETS

1—650-kva. Westinghouse-Parsons, 480/240-volt 3-ph., 60-cy., 3600-r.p.m., with Westinghouse Le Blanc jet condenser and exciter.

If your requirements are not listed, write us, as we do not attempt to list our entire stock.



J. L. HEMPHILL & CO. Inc.

ELECTRICAL ENGINEERS AND EQUIPMENT

1118-1120 Clinton Street, Hoboken, N. J.

Phones: Hoboken 3618-3619

A. C. MOTORS—3 PHASE, 60 CYCLE

No.	Hp.	Rpm.	Volts	Make
1	400	450	2200	G.E., synch.
1	310	600	2200/440	G.E., synch.
2	200	900	220/440	G.E., L
1	200	720	220/440	Cr.-Wh., sl.rg.
1	150	600	220/440	Cr.-Wh.
1	100	690	220/440	Westghse.CCL
1	50	1200	220/440	Cr.-Wh.,sq.cg.
1	50	900	220/440	Westghse.,sl.rg
1	40	1700	220/440	Westghse.,sl.rg
1	40	900	220/440	G.E., sq. cg.
1	40	840	220/440	Cr.-Wh.,sq.cg.
1	35	900	220/440	G.E., type I
1	30	1200	220/440	G.E., sq. cg.
1	30	900	220/440	Westghse., MS
1	30	1800	220/440	Westghse.,CW
1	25	1200	220/440	G.E., K
1	20	900	220/440	Otis Elev.
1	20	900	220/440	G.E.,sq.cg.
5	20	1200	220/440	G.E., sq. cg.
4	15	1200	220/440	G.E., K
2	7½	900	220/440	G.E., form K
1	7½	1200	220/440	G.E., form K
1	7½	1800	220/440	G.E.
3	5	1800	220/440	C.S., form C and Westghse.
1	3	1200	220/440	G.E.
1	3¼	600/1800	440	G.E., new var. speed
4	2	1800	220/440	G.E.
1	1	1800	220/440	Robbins & M.

2-Phase Motors on request

D. C. GENERATORS—250 VOLT

1	200	575	G.E.
1	100	580	Westghse.
1	75 kw.	600	Westghse.
1	50	600	Westghse.
1	30	900	Westghse.
2	15	900	Allis-Chal.

D. C. GENERATORS—230 VOLT

1	30 kw.	1030	C.-W., CCD

D. C. GENERATORS—125 VOLT

5, 10, 20, 25, 40, 50 Kw.

D. C. MOTORS—230 VOLT

No.	Hp.	Rpm.	Make
1	250	500	G. E.
1	115	1125	West. S.
2	100	500	Diehl
2	75	750	Diehl
1	55	675	Diehl
1	50	200	Diehl
1	35	700	Cr.-Wh.
1	25	1300	Sprague
3	25	600/1200	Allis-Chal.
1	20	650	G. E.
1	20	700	Holtzer Cabot
1	15	750	Holtzer Cabot
1	15	1250	Allis-Chal.
1	10	1200	Allis-Chal.
1	10	850	G. E.
3	10	275/1575	Allis-Chal.
1	7.5	625	G. E.
1	3	1150	G. E., new
1	½	375	Holtzer Cabot

D. C. MOTORS—125 VOLT

1	35	875	West.
1	20	650	Allis-Chal.
1	15	775	SK, Westg.
1	5	700	Diehl
3	3	1100	G. E.
2	3	1700	G. E.

A. C. GENERATORS

No.	Kw.	Rpm.	Volts	Make
1	300	450	2300	G. E., P
1	200	600	2300	G. E.,
1	100	900	2200	West. G
1	50	1200	2200	West. G

TURBINES

1—475-kva., 3600 r.p.m., 3 ph., 60 cy., 220/440 v., Westinghouse, non-condensing, with direct connected exciter.

TURBO GENERATOR

1—150-kw. De Laval, Crocker-Wheeler 3-wire, 125/250-v., complete, operated one year.

ENGINE GENERATOR SETS

1—450-kw., Westinghouse, 250-275 v., C.W., D.C. engine type generator, speed 125, direct connected to simple Hamilton Corliss engine, cylinder 30x36; all usual accessories, fine shape.

1—250-kva. Westinghouse, 3-ph., 220/440-v. engine type generator, 200 r.p.m., dir. conn. to McIntosh & Seymour tandem cpd. engine, 15 x 26 x 17, belted exciter, switchboard.

1—200-kw., 250-v., D.C. Gen. connected to Allis-Chal., 18 x 36 right-hand Corliss Engine.

1—100-kw., 125 v., 2-wire, D.C. Westinghouse, R.H. gen. conn. to Harrisburg std. tand. cud., 11 x 18 x 13 engine, 275 r.p.m., complete.

2—75-kva. General Electric, 257 r.p.m., 3-ph., 60-cy., 440/2300-v., dir. conn. engine generator sets.

1—75-kw. Crocker-Wheeler 240 v., 3 ph., 60 cy., dir. conn. to 14x14 Ames Uniflow Simple Eng. Complete with switchboard and exciter.

MOTOR GENERATOR SETS

300-kw., 720-rev., 125/250-v., 3-unit set consisting of (2) 150-kw., 125-v., D.C., G. E. gen. (1) 450-hp., sq. ca., 440/2300-v. motor.

200-kw., 600-rev., 250-v., Westghse. Gen., 350-hp., 440/2300-v. syn.

120-kw., 720 r.p.m., 250-v., Westghse. Gen., 175-hp., 2300/4100-v. syn. motor.

100-kw., 250-v., Gen. Elec. Gen., 900 r.p.m., 220/440-v. syn. motor.

50-kw., 720-rev., 250-v. West. Gen., 75-hp., 220/440-v. motor.

10-20-25-40-kw., 125-v. Exciter Sets.

5-kw., Balancer set on common bed.

TRANSFORMERS

1—3-ph., oil-insulated, self-cooled, O.D. type, 5000 kva., 44,000 v. delta, 22,000 v. Y. Now connected 22,000 v. delta high side—11,000 v. low side.

GEORGE SACHSENMAIER COMPANY

926 North 3rd Street, Philadelphia, Pa.

RELIABLE EQUIPMENT

Largest Stock in America

Transformers

Single Phase

Qu.	Kva.	Make	Cy.	Type
1	15	Moloney Voltage, 2200x110/220	60	.....
1	15	Westghse. Voltage, 2200x220/440	60	S
1	17½	Moloney Voltage, 220x360/x17	60	.....
1	20	Westghse. Voltage, 2200x575	60	.....
1	20	Gen. Elec. Voltage, 2200x575	60	.....
1	25	Gen. Elec. Voltage, 575x215	60	HK
2	25	G. E. NEW Voltage, 11000/9900x230	60	HG
1	25	Westghse. Voltage, 6600/6300x110/220	60	3-phase
3	50	Gen. Elec. Voltage, 2200x110/220	60	H
4	50	Pittsburgh Voltage, 220 to 220/110	60	2-3-phase
2	75	Moloney Voltage, 2300x600	60	HE Scott Taps
	75	Kuhlman Voltage, 2200x220/440	60	.....
2	75	Gen. Elec. Voltage, 2200x110/220	60	ALCCD
1	75	Westghse. Voltage, 2200x110/220	50-140	.....
4	100	Pittsburgh Voltage, 2200x220	60	.....
	100	Elec. Fur. Co. Voltage, 2200x120/216	60	.....
	100	Westghse. Voltage, 2200x220	60	.....
2	100	G. E. NEW Voltage, 11000/9900x2300	60	HRTQ
3	100	Gen. Elec. Voltage, 6600/5940x1092/1150	60	HRP
14	100	Gen. Elec. Voltage, 2400x240/480	60	HK
7	100	Gen. Elec. Voltage, 2400x240/480	60	ALCCD
2	150	Westghse. Voltage, 2300x382	60	.....
2	150	Gen. Elec. Voltage, 2300x220	60	HRP
3	185	Gen. Elec. Voltage, 33000x430	25	.....
4	350	Gen. Elec. Voltage, 33000 13200x6600	60	HRR
1	500	Gen. Elec. Voltage, 2400x110/220	60	HKDH
4	3500	NEW Gen. Elec., continuous 55 deg. C. rise, type H, form VDDJ circular coil design, cycles 50 (suitable for 60 cycles) volts, 16500/33000 to 3000, 11 to 1 ratio. Taps 33000, 32175, 31350, 30525, 29700, 16500, 15675, 14850. Various voltage changes can be made by rearrangement of coil connections. What do you require?		

Some Cash Bargains
MOTORS
ALL NEW

1000 NEW ¼-hp., single-phase, 60-cycle Westinghouse motors, 110-volt, type CAH, 1725-r.p.m.

Singly	$14.40
Lots of 10	13.00
Lots of 25	12.00
Lots of 50	11.50

1000 NEW 1-6-hp., single-phase, 60-cycle Westinghouse motors, 110-volt, 1750-r.p.m.

Singly	$12.15
Lots of 10	11.00
Lots of 25	10.25
Lots of 50	9.50

NEW 1-3-hp., single-phase, 60-cycle, General Electric Motors, 1150-r.p.m. Can furnish in either 110 or 220 volt.

Singly	$31.50
Lots of 5	27.50
Lots of 10	25.00

NEW 1-3-hp., direct current General Electric Motors, 1150-r.p.m., 110 and 220 volt.

Singly	$24.75
Lots of 5	22.50
Lots of 10	20.00

TURBINES

1—300-kw., 440-volt, 3-phase, 60-cycle, 3600-r.p.m. Westinghouse Generator to a Westinghouse-Parsons steam turbine, complete with Wheeler Condenser & Engineering Co. Admiralty type condenser; also Blue Vermont marble panel for generator with three 600-amp. ammeters; one 100-amp. D.C. ammeter; one 600-volt, A.C. voltmeter on swinging bracket with exciter switch, main switch and rheostat.

1—300-kw. Westinghouse, direct current Generator, Serial No. 1821519, 900-r.p.m., 500-amp., 550/600-volt, direct connected to No. 3292 Westinghouse steam turbine, 6000-r.p.m. This turbo generator could be used for belt drive by using pulley in place of generator. A new alternating current generator could be bought to replace the direct current machine and make a very fine unit.

1—375-kva., 3-phase, 60-cycle, 2300-volt, 900-r.p.m. Westinghouse Generator connected through reduction gear to Westinghouse frame 3-EHNC turbine, condensing, with switchboard.

2—500-kva., 2-phase, 60-cycle, 2400-volt, 3600-r.p.m. Westinghouse-Parsons turbo Generators, each with No. 4 LeBlanc turbine-driven condenser, without switchboards.

1—625-kva., 3-phase, 60-cycle, 2300-volt, 900-r.p.m. Westinghouse Generator connected through reduction gear to a frame 6-EHC Westinghouse turbine with Westinghouse-LeBlanc turbine driven condenser, with switchboard.

1—6500-kva., 3-phase, 25-cycle, 6600-volt, 750-r.p.m. Allis-Chalmers Generator to Allis-Chalmers turbine, condensing type.

EXCITER SETS

4—25-kw., 125-volt NEW General Electric Marine type units.

4—12 ½-kw., 125-volt, NEW, type SK Westinghouse Generators to American Blower Engines.

1—15-kw., 125-volt General Electric Marine type Unit, slightly used.

Motors

3 Phase, 60 Cycle

Qu.	Hp.	Make	Volt	Type	Speed
*11	5	Triumph	220	B7	1720
*5	5	Triumph	220	B8	1140
*3	5	Fairbanks	440	H8AB	1800
*7	5	Fairbanks	220	H8AB	1800
1	5	Cr.-Wh.	220	111Q	1800
*1	5	Cr.-Wh.	550	.....	1720
1	5	Fbks.-M.	220	B	1800
*1	5	R. & M.	550	K	1750
*2	7½	Supreme	220/440	MO	1800
*2	7½	Supreme	220/440	MO	1200
*4	7½	G.E. Sl. rg.	220	MT181	1800
*1	7½	Lincoln sl.rg.	220	IXF	1800
*5	7½	R. & M.	220	K	1200
*1	10	Supreme	220/440	MO	1800
*3	10	Supreme	220/440	MO	1200
1	10	G.E.,sl.rg.	220/440	MT182	1800
1	10	Al.-Chal.	440	AN	1150
*2	10	Al.-Chal.	220	AN	1800
*1	10	R. & M.	550	K	1200
1	20	Fbks.-M.	220	KBV	1200
*1	20	Triumph	220	TR	690
*1	20	Lincoln	220	C11	1200
1	20	Howell	440	.....	1200
*3	20	G.E.	440	KT312	1200
1	20	G. E.	440	KT322	1200
1	20	Westghse.	220	CCL	1130
1	20	Westghse.	550	CCL	1120
*1	25	Westgh. sl. rg.	220/440	CW	850
*1	25	G. E. sl. rg. inter-mit. duty	220/440	ITC5011A	850
2	25	R. & M.	220/440	K207	1150
1	25	Westghse.	440	CS	1160
1	25	Westghse.	2200	CCL	690
1	25	Westghse.	220	CX	1120
1	25	G. E.	220	KT312	1800
1	25	G. E.	220	KT326	1165
*4	25	G.E.	440	KT322	1200
3	25	G. E.	440	KT326	1200
*1	25	G.E.	440	IT6	1200
*1	25	W.E.	440	KT322	1200
1	25	Cr.-Wh.	440	118Q	1150
1	30	Fbks.-M.	440	B	900
*2	30	G.E.	440	KT322	900
*1	30	Wag.	440	BP	850
1	30	Westghse.	550	CS	1140
6	30	Westghse.	440	CCL	850
2	35	Lincoln	440	C13	1200
1	35	G. E.	220	KT336	865
1	35	Wagner	440	TBW	1140
*1	35	Westgh. sl rg.	220/440	CW	850
1	40	G. E synch.	480	ATI	1200
1	40	G. E. synch.	480	ATI	1200
*9	40	G.E.	440	KT336	900
*3	40	G.E.	440	KT332	1200
1	40	Lincoln	440	C12	1800
1	40	Wagner	550	BP	850
1	50	G. E.	440	IK	900
*1	50	G.E.	2200	IK	600
1	50	G. E.	550	IK	900
1	50	Lincoln	550	IL	900
1	50	Westghse.	440	C	1200
1	50	Allis-Chal.	440	AN	865
1	50	Ft. Wayne	440	MC	900
1	60	Wagner, sl. rg. inter-mit. duty	440/220	BR	810
*1	60	G.E.	440	KT343	1200
3	75	G. E.	440	ITC5013	600
*1	75	G.E.	440	KT356	720
1	75	G.E.sl.rg.	220	M	720
1	150	Westghse.	220	CS	1200
1	150	G. E.	2200/440	L	600
1	200	Westghse.	2200	CCL	600
1	300	West. 3 brg.	2000	C	495
1	300	Al.-Ch. syn.	440	.....	600
2	500	C.-W. syn.	440	.....	1200

*Unused

We have a complete stock of 110-220-500 D. C; 60 and 25 cycle motors; also single phase motors—all sizes. Thousands of fractional horsepower single phase motors, standard makes, at attractive prices.

USED
TRANSFORMERS

3—333 kva., Packard, OISC. 60 cy., voltage 13200/12000 x 480/440.
4—300 kva., Packard, OISC. 60 cy., voltage 2200 x 440.
3—300 kva., Westg. OISC. 60 cy., voltage 6600 x 440.
3—150 kva., Packard OISC. 60 cy., voltage 6600 x 440.
3—125 kva., Moloney OISC. 60 cy., voltage 33,000 x 230/460.
3—125 kva., Kuhlman OISC. 60 cy., voltage 33,000 x 2300/4600.
3—100 kva., Gen. Elec. OISC. 25 cy., voltage 2200 x 440/220.
3—100 kva., Gen. Elec. OISC. 60 cy., voltage 11,000 x 440/220.
3—75 kva., Moloney OISC. 60 cy., voltage 2200 x 110/220.

FREQUENCY CONVERTER

2500 Kva. WESTINGHOUSE
Gen.: 2 ph., 62½ cy., 750 r.p.m.
Motor: 3 ph., 25 cy., 750 r.p.m.
(Voltage made to suit conditions)

SLIP RING MOTORS

250 Hp. GENERAL ELECTRIC
3 ph., 60 cy., 440 v., 600 r.p.m.
225 Hp. GENERAL ELECTRIC
3 ph., 25 cy., 440 v., 500 r.p.m.

SURFACE CONDENSERS

2100 ft. Wheeler Condenser & Engrg. Co.
1000 ft. Wheeler Condenser & Engrg. Co.

NEW
SYNCHRONOUS CONVERTERS

12—670 Kw. G.E., Type HCC, Form J, 25 cy., 2200 Amp. 240/300 v. D.C. Booster Type. Complete with Switchboard.

TRANSFORMERS

12—700 Kva., G.E., Type HTH. Form DDJ. 25 cy., 3 ph., 6600 v. prim. Complete with oil.

LIGHTNING ARRESTERS

4—Westinghouse, Type AK, Electrolytic Lightning Arresters, 70,000 v. with horn gaps.

DISCONNECTING SWITCHES

G.E. Type L.G.-19, 70,000 v., 300 Amp. Outdoor.
G.E. Type L.G.-19, 22,000 v., 300 Amp. Outdoor.
G.E. Type L.G.-16, 15,000 v., 300 Amp. Indoor.
G.E. Type L.G.-107, 70,000 v., 300 Amp. Outdoor.

CHOKE COILS
INSTRUMENTS
SERIES TRANSFORMERS
POTENTIAL TRANSFORMERS
SWITCHBOARD FITTINGS

USED
A.C. and D.C. UNITS

6500 Kw., TURBO-UNITS
Generator: 3 ph., 25 cy., 6600 v.
Turbine: Allis-Ch. Hor. 750 r.p.m.

765 Kva., TURBO-UNIT
Generator: 3 ph., 60 cy., 2300 v.
Turbine: West.-Parsons, Hor. 3600 r.p.m. (with jet condenser, pumps and accessories)

200 Kva., ENGINE UNIT
Generator: Crocker-Wh., 3 ph., 60 cy., 240 v.
Engine: Buckeye, 18x27, 150 r.p.m.

75 Kw. ENGINE UNIT
Generator: Westinghouse, 2 ph., 60 cy., 240 v.
Engine: Buckeye, 13x16, 240 r.p.m.

150 Kw., ENGINE UNIT
Generator: Crocker-Wh., 125 v., D.C.
Engine: Harrisburg-Fleming, 18x17, 225 r.p.m.

50 Kw., ENGINE UNIT (3 wire)
Generators: 2—25 kw. Sprague, 125 v. D.C.
Engine: Ames, 13x11, 300 r.p.m.

15 Kw., TURBO-UNIT
Generator: G. E. 125 v. D.C.
Turbine: Curtis, Hor., 4500 r.p.m.

MOORE & MAC DONALD
EQUIPMENT ENGINEERS
26 Cortlandt St. Tel. Rector 5325 **New York, N. Y.**

60-CYCLE TRANSFORMERS

2—2500-kva. G. E., 3 ph., 30,000-60,000 v. prim., 14,500 secy.
1—1500-kw. G. E., 3 ph., 13,200 v. prim., 6600-2200-550 v. secy.
2—1000-kw. Westghse., 33,000 v. primary, 2300 v., Scott conn. secy.
3—1000-kva. Westghse., single ph., 6600 v. prim., 2300 v. secy.
3— 500-kva. Westghse., single ph., 13,200 v. prim., 2300 v. secy.
3— 500-kva. G. E., Type H., 2200 v. primary, 550 v. secondary.
3— 400-kva. G. E., Type H, 2400 v. primary to 240 v. secondary.
4— 400-kva. Pittsburgh, 6600 v. primary, 440-220 v. secondary.
2— 250-kw. G. E., Type H, 13,200 v. prim., 2300 v. secy., Scott conn.
3— 250-kva. G. E., Type WC, 13,200-11,880 v. prim., 2300 v. secy.
3— 250-kva. Pittsburgh, 13,200 v. primary, 2300 v. secondary.
3— 250-kw. Stanley, 13,200 v. primary, 2300 secondary.
3— 250-kva. Westghse., 4400-2200 v. primary, 440-220 v. secondary.
3— 200-kva. Westghse., 6400 v. primary, 2200 v. secondary.
6— 200-kva. G. E., Type H, 34,600-60,000 v. prim., 440-220 v. secy.
3— 200-kva. G. E., Type H, 34,600-60,000 v. prim., 2300 secy.
3— 200-kva. G. E., Type H, 2200 v. primary, 244-488 v. secondary.
3— 200-kva. G. E., 13,200 v. primary, 220-440 v. secondary.
3— 150-kva. G. E., 6600-6300-6000 v. primary, 120-240 v. secondary.
3— 150-kva. Pittsburgh, 11,000 v. primary, 155-186 v. secondary.
3— 100-kva. G. E., Type H, 6600 v. primary, 605-545 v. secondary.
3— 100-kva. G. E., 2300 v. primary, 220-110 v. secondary.
2— 100-kw. Ft. Wayne, Type A, 13,200 v. prim., 2300 v. sec., Scott conn.
2— 100-kw. Westghse., Type S, 440 v. primary, 220 v. secondary.
4— 100-kva. Pittsburgh, 2200 v. primary, 110-220 v. secondary.
5— 100-kw. G. E., Type H, 6600 v. primary, 373-385-397 v. secy.
3— 100-kw. Westinghouse, 2200 v. primary, 440 v. secondary.
9— 100-kva. G. E., Type H, 34,600-60,000 v. prim., 440-220 v. secy.
6— 100-kva. G. E., Type H, 34,600-60,000 v. prim., 2300 v. secy.
3— 100-kva. G. E., 13,200 v. primary, 220-440 v. secondary.
2— 75-kva. G. E., Type H, 2000 v. primary, 575 v. secondary.
3— 75-kva. G. E., Type H, 11,000-9900 v. prim., 6600 v. secy.
3— 75-kva. Pittsburgh, 2200 v. primary, 110-220 v. secondary.
1— 50-kva. G. E., Type H, 550 v. primary, 220-110 v. secondary.
1— 40-kva. Westghse., 7600 v. primary, 440 v. secondary.
1— 40-kva. G. E., Type H, 550 v. primary, 220-110 v. secondary.
3—37½-kva. Westinghouse, 2200 v. primary, 575 v. secondary.
1—37½-kva. Pittsburgh, 2200 v. primary, 110-220 v. secondary.
1— 25-kva. Kuhlman, 3 ph., 2400-4800 v. primary, 480 v. secondary.
14— 25-kva. Pittsburgh, 2200 v. primary, 220-440 v. secondary.
3— 25-kva. Pittsburgh, 2200 v. primary, 220-110 secondary.
2— 20-kva. G. E., Type H, 550 v. primary, 220-110 v. secondary.
3— 15-kva. Westghse., 2300 v. primary, 575-287½ v. secondary.
1— 10-kva. Pittsburgh, 2300 v. primary, 230-460 secondary.
1— 7½-Kva. Westinghouse, 2200 v primary, 575 v secondary

25-CYCLE TRANSFORMERS

2—2500-kva. G. E., 3 ph., 30,000-60,000 v. prim., 14,500 v. secy.
1—1500-kva. G. E., 13,200 v. primary, 6600 v. secondary.
6— 500-kva. Westghse., 13,200 v. primary, 6600 v. secondary.
3— 500-kva. Westghse., single ph., 13,200 v. prim., 2300 v. secy.
6— 100-kw. G. E., 13,200-11,880 v. primary, 185-370 v. secondary.
3— 75-kva. G. E., Type H, 12,500-11,750 v. prim., 678 v. secy.

If you do not find transformers of size and characteristics required write us and we will quote you from our available list.
We also have on hand complete equipment from a transformer sub-station from 33,000 volts to 13,200 and 2200 volts, including lightning arresters, disconnecting switches, panelboards and instruments.

ARCHER & BALDWIN, INC.
114-118 Liberty St., New York City. **Tel. 4337-4338 Rector**
Send for description and prices

"25 CYCLE" MOTORS, TRANSFORMERS, MOTOR GENERATOR SETS

FOR SALE:

Over 300—25 cy., 3 ph., totaling 8000 hp., in sizes 1 to 750 hp., **Squirrel Cage.**

37—15's, 7—20's, 5—25's, 6—30's, 26—35's, 13—40's, 21—50's, 3—60's, 17—75's, 10—100's, 8—150's, 1—300, 1—350, 1—375, 1—450.

Slip Ring—43 Motors from 5 to 750 hp.
Vertical—20 Motors from 2 to 20 hp.
Transformers—Single and 3 ph., from 1 to 200 kva.
Meters—Over 200 watthour and switchboard type.
Switchboards—35 with and without instruments and switches.

Frequency Changers.

2—1250 kva. Westinghouse	each	$11,800
1—1000 kva. General Electric		10,300
1— 800 kva. General Electric		apply
1— 500 kva. General Electric		6,300
1— 150 kva. General Electric		4,100

Rotary Converters 13200 and 6600 v. to 275 v.

1—2000 kw. General Electric.
2—1500 kw. General Electric.
1— 750 kw. General Electric.

Prices quoted F.O.B. cars Kansas City, Mo.

Prices subject to change without notice and subject to prior sale.

Many items almost new and all were in operating condition when removed from service.

For details and prices, address

KANSAS CITY POWER & LIGHT CO.
KANSAS CITY, MO.
Attention: W. C. Blair, *Industrial Engineer*

Power Machinery Exchange

1 Montgomery Street, Jersey City, N.J.

A. C. DIRECT CONNECTED UNITS

3-Phase, 60-Cycle

Kva.	Generator	Engine
625	Westghse.	Parsons Bleeder type
625	Gen. Elec.	Curtis Turbine
500	Gen. Elec.	Skinner
500	Westghse.	Parsons turbine
500	Ridgway	Ridgway, 4-valve
475	Gen. Elec.	Skinner Universal Uni.
470	Westghse.	Parsons Turbine
400	Cr.-Wheeler	Hamilton Corliss
375	Gen. Elec.	Curtis Turbine
315	Ridgway	Ridgway
300	Burke	Erie Ball, 4-valve
350	Gen. Elec.	Harris Corl.
300	Gen. Elec.	Curtis Turbine
300	Gen. Elec.	Hamilton Corl.
300	Allis-Chal.	Skinner
240	Gen. Elec.	Buckeye
250	Allis-Chal.	Allis-Chal.
250	Gen. Elec.	Erie Ball, 4-valve
240	Gen. Elec.	Buckeye
200	Westghse.	Erie Ball, 4-valve
200	Gen. Elec.	Ames Unaflow
185	Gen. Elec.	Chuse, 4-valve
175	Allis-Chal.	Allis-Chal.
165	Westghse.	Erie Ball
150	Gen. Elec.	Skinner
150	Gen. Elec.	Ames
125	Gen. Elec.	Harrisburg, 4-valve
120	Gen. Elec.	Hamilton, 4-valve
110	Allis-Chal.	Skinner
100	Westghse.	Erie Ball
100	Cr.-Wheele	Harrisburg
90	Gen. Elec.	Skinner Unaflow
90	Gen. Elec.	Ames Uniflow
75	Ridgway	Ridgway
75	Gen. Elec.	Skinner
70	Westghse.	Harrisburg
50	Gen. Elec.	Skinner
50	Westghse.	Erie
50 (2)	Gen. Elec.	Ames Uniflow
35	Gen. Elec.	Skinner Uniflow

Unaflow Units

50 kva. General Electric 3-ph., 60-cy. Alternator, direct connected 12x12 Ames Unaflow Engine. 2 yrs. service. Like new, $2000.
60 kva. Ditto, $2250.

100 kva. Crocker-Wheeler 3 Ph. 60 Cy. Alternator dir. con. 13x12 Harrisburg Side Crank Engine. A1 condition $2000.

4 Valve Unit

187 kva. General Electric 3-ph., 60-cy. Alternator, dir. con. 15x24 Erie Ball 4-valve Engine. Seen operating. Immediate delivery. $3250.

Boilers, Engines, Motors and Generators All sizes. Write for information

D. C. DIRECT CONNECTED

Kw.	Generator	Engine	Volts
300	Cr.-Wheeler	Watts-Campbell-Corliss	250
300	G.E. (3 wire)	Erie Ball, 4-valve	250-125
250	Ridgway	Ridgway, side crank	250
200	G.E. (3 wire)	Ames	250-125
200	Gen. Elec.	Erie, 4-valve	250
200	Gen. Elec.	Harrisburg	250
160	Gen. Elec.	Skinner	125
150	Ridgway	Ridgway, 4-valve	125
150	Gen. Elec.	Skinner	250
125	Gen. Elec.	Harrisburg 4-valve	125
120	Gen. Elec.	Harrisburg, side crank	250
100	Gen. Elec.	Erie Ball	125
100	Gen. Elec.	Harrisburg	250
100	Gen. Elec.	Harrisburg Unaflow	125
75	Gen. Elec.	Harrisburg	125
75	Wghse. (3 wire)	Ames	250-125
75	Burke (3 wire)	Hamilton, 4-valve	250-125
60	G.E. (3 wire)	Skinner Uniflow	250-125
60	Gen. Elec.	Harrisburg	125
50	Gen. Elec.	Skinner	125
35	Gen. Elec.	Harrisburg	250
25	Westghse.	Ames	125
17½	Westghse.	Erie	250

A. C. BELTED GENERATORS

3-Phase, 60-Cycle

Kva.	Make	Speed
625	Allis-Chal.	257
600 (3)	Gen. Elec.	200
550	Allis-Chal.	200
540	Gen. Elec.	360
500	Gen. Elec.	360
450 (2)	Gen. Elec.	200
400	Gen. Elec.	360
360	Westghse.	360
300	Gen. Elec.	720
250	Westghse.	600
200	Gen. Elec.	600
150	Gen. Elec.	600
100	Gen. Elec.	900
75	Gen. Elec.	900
75	Westghse.	900
56	Gen. Elec.	1200
45	Gen. Elec.	1200
37½	Gen. Elec.	1200
25	Gen. Elec.	1200

Serviceable Power Equipment **WE BUY** *What Have You to Offer?*

Adjustable Speed Motors

Hp.	Rpm.	Volts	Make	Type
1—100	475/950	230	Westinghouse (NEW)	SK-180
1— 50	450/900	230	General Electric	DLC-8A
1— 50	500/1000	115	Northern	G. E.
2— 35	500/1000	115	Northern	G. E.
2— 30	500/1000	115	Northern	G. E.
2— 30	210/800	230	Electro Dynamic	308
1— 25	725/1200	230	General Electric	CL
1— 25	300/800	230	Electro Dynamic	258
1— 20	650/1900	230	Westinghouse (Semi-enc.)	SK-120
5— 20	515/1030	115	Northern	G.E.
1— 14	900/1800	500	General Electric	CQ-C10
5— 10	1000/1500	230	Sprague	LC
1— 10	300/1200	230	Electro Dynamic	S
1— 10	400/1200	230	General Electric	RF
1— 10	850/1700	230	Westinghouse	SK
2— 7½	1000/1500	230	Sprague	LC
3— 7½	850/1700	230	Westinghouse	SK-60

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1—750-kw., Syn. G. E. Converter, 240-120-v. Panels, Transformers, 3-60-13,800 or 6900 v.
1—500-kw., Syn. G. E. Converter, 240-120-v. Panels, Transformers, 3-60-13,800 or 6900 v.
1—775-kva., Westinghouse-Hamilton Engine Set, 3-60-480 v.
1—NEW 500-kw. Allis-Chalmers Turbo, 3-60-480 v.
1—300-kw., Allis-Chalmers Skinner Eng. Set, 3-60-240 v.
1—250-kw., 125-v. Deihl Generator, d.c. to Kerr Turbine.
1—150-hp., General Electric 3-60-220-v. Motor Generator Set, 250-125 v.
1— 75-kw., Allis-Chalmers Skinner Eng. Set, 250 v.
6—333-kva., Pittsburgh, single phase, 60-cy. Transformers, primary 13,200 v., secondary 2300 v.
3—200-kva., Packard, single phase, 60-cy. Transformers, primary 13,200 v., secondary 575 v.
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3—1730-ft. OCE Chicago, dir. conn. elec. Compressors, 3-60-2200-550-440-220-v. Receivers, Aftercoolers.
4—72-in.x19-ft., 6-in. HRT, Mass. Std. Boilers, breeching, all fittings, pumps, feed water heater, making complete heating plant, serving 60,000-sq. ft. radiation.

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SPECIAL PURPOSE MOTORS

Vertical Type

1—1-hp. Century, vert., 1 ph., 60 cy., 110-220 v., 1750 r.p.m.
4—13-hp. Crocker-Wheeler Vert. Motors, 220 v., D.C., 1150 r.p.m.
1—40-hp. G. E. Vert. Slip Ring, 3 ph., 60 cy., 220 v., 1150 r.p.m.

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1—1-hp. Burke, back gd., 2 ph., 60 cy., 220 v., 1800 r.p.m.

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9—2-hp. General Electric KT Motors, double shaft extension, 3 ph., 60 cy., 220 v., 450 r.p.m.
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1—3-hp. Imperial, elevator rating, 3 ph., 60 cy., 220 v., 1000 r.p.m.
2—15-hp. G. E. Motors, elevator rating, 3 ph., 60 cy., 220 v., 900 r.p.m.

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7—3-hp. General Electric BSS, variable speed, 1 ph., 60 cy., 110-220 v., 900-1800 r.p.m.
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3—10-hp. Watson Multi-Speed Motors, 3 ph., 60 cy., 220 v., 580-850-1140-1720.

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1—3-hp. Crocker-Wheeler, 220 v., D.C., 250 r.p.m.
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1—1-hp. Robbins & Myers Bench Grinder, 3 ph., 60 cy., 220 v., 1800 r.p.m. (new).
2—2-hp. U. S. Tool Co. Pedestal Grinders, 3 ph., 60 cy., 220 v., 3400 r.p.m.

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1—4/4.8 hp. General Electric, 3 ph., 60 cy., 220 v., 3450 r.p.m., dir. conn. to G. E. Cent. compressor, 15-lb. pressure.

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ASK FOR OUR STOCK ON HAND BULLETIN No. 101 JUST PUBLISHED

300 kw., 250-v. D.C. Gen. Elec., coupled to 325 kva., 3-ph., 60-cy., 2300-v. A.C. Gen. Elec. synchr. motor. Price, $3825.

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"HONESTLY REBUILT"

150 kw., 250-v. D.C. Gen. Elec., "Ft. Wayne" 900 r.p.m., 3-ph., 60-cy., 2300-v. A.C. synchr. Motor Generator Set.

1—200-hp., 3-ph., 60-cy., 440-v. Gen. Elec., type I, Form L, 600 r.p.m. Motor. Price $1000.

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1—37½ kw., 250-v. D.C. Westinghouse, 3-ph., 60-cy., 220-v. Motor Generator Set with switchboard. Price $1100.

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SINGLE PHASE MOTOR BARGAINS

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1— 10 hp., 870 r.p.m., 110-220 v., 60 cy., Wagner.
1— 10 hp., 1165 r.p.m., 110-220 v., 60 cy., Century.
5—7½ hp., 1750 r.p.m., 110-220 v., 60 cy., Wagner.
1— 5 hp., 1750 r.p.m., 110-220 v., 60 cy., Wagner.
3— 3 hp., 1750 r.p.m., 110-220 v., 60 cy., Wagner.
1— 3 hp., 1800 r.p.m., 110-220 v., 60 cy., General Electric.

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3—New 408-hp. Heine, 180 lb., with stkrs.
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$5.00 per H.P.

Green Chain Grate with Arches, etc. Can be made larger or smaller.

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New 12,500 kva. Turbo with Sur. Cond.
NEW 625 KVA., 480-240-v., NON-COND.
1500-1000-650 KW., MIXED PRESS., 240-480-2300 v.
1500-750 KW., 2300-V. TURBOS.

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1000-kw., 125-250-v., Low Press. Turbo.
800-kw., 250-v., Turbo and Cond.
1000-750-500-hp., 60-cy. Motors.

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Generators—Motors

100-hp. General Electric Motor, Type I, form K, 440 v., 3 ph., 25 cy., 500 r.p.m., 40 deg., complete with pulley, base, no voltage release compensator and oil circuit breaker; practically new.
300 kva. General Electric Generator, type ATI, 440 v., 3 ph., 60 cy., 720 r.p.m., complete with separate type CVC exciter and rheostats.
Large stock of variable speed direct current motors in all sizes; also large stock of constant speed direct current motors. Can furnish any size motor in alternating current. You can save considerable on our prices.

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New and Nearly New

O. I. S. C. outdoor type, single phase, 60 cy., 6,600 to 6,900 or 11,400 to 11,900 v., "Y" to 220/440 secondary.
12—100 kw.@$300.
3—150 kw.@$375.
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5—300 kw.@$550.
2—50 kw. with 120/240 Sec.@$250.

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"Two General Electric indoor water cooled, type transformers, with the following description:

Type WC, form EITQ, 66 cy., 1000 Kv.A., 15,500/31,000 v., 3 ph., 2400/4800 v., 2 ph.

These transformers arranged for secondary, two or three phase connections and are in operating condition, at $1,100.00 each, f.o.b. Appleton, Wisconsin.

Wisconsin Traction, Light, Heat & Power Co.
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1—75-hp. Lincoln, 3-ph., 60-cy., 860 r.p.m. motor, direct connected to 46 kw., 125-v. generator.
2—60-hp. Lincoln, 3-ph., 60-cy., 900 r.p.m. motors, direct connected to 37½ kw., 110-v. generators.
2—45-hp. Lincoln, 3-ph., 60-cy., 720 r.p.m. motors, direct connected to 30 kw., 125-v. generators.

All mounted on common iron beds.

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Slip Ring Type—Practically New
3 ph., 25 cy., 440 v., 485 r.p.m.

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1—35-ton, 8-wheel BROWNING Loco. Crane, new 1921, A.S.M.E. boiler, 60-ft. boom, double drums, M.C.B. trucks, like new; located New York City.

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Steam Engine Generator Sets
Turbine Generator Units
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New Compensators

60-CYCLE	Each
20— 7½-hp., 220-volt, 3-phase	$35
2—10 -hp., 220-volt, 3-phase	37
1—15 -hp., 440-volt, 2-phase	38
7—20 -hp., 220-volt, 3-phase	40
1—25 -hp., 550-volt, 3-phase	40
1—30 -hp., 220-volt, 2-phase	43
1—75 -hp., 440-volt, 3-phase	80
25-CYCLE	
6—10 -hp., 440-volt, 3-phase	37
3— 5 -hp., 550-volt, 3-phase	32
1— 5 -hp., 440-volt, 3-phase	32

All G. E., H-3 with overload relay, no-voltage release and oil. Offered subject to prior sale. Other machinery bargains.

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Direct connected Erie City engine and General Electric A.C. generator, 3 ph., 60 cy., 240 v., amp. 181, speed 200, k.w. 60, type A T B 36-75-200.

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Copper Wire

Any part or all of 80,000 lb. of No. 4 or No. 2 bare. Must be in good shape. Copper clad or aluminum in equivalent conductivity will be considered. State price and shipping weight.

Union Power Company, Limited
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WANTED

Motor or Generator

125-175 hp. D.C., with rheostat, 220 to 250 v., speed about 600 to 900 r.p.m.

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2—750 kilowatt turbines either 440 or 2200 volts, 3 phase, or would consider one unit 1500 kw. to 2000 kw.

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any part or all of
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180 wall feet 35 to 45 ft. lengths
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4—525 hp. B. & W., 165 lbs., Rohney Stokers.
6—440 hp. B. & W., ASME code, 200 lbs. practically new, Murphy Stokers and Diamond Soot Blowers.
2—440 hp. B. & W., 200 lbs. Murphy Stokers.
3—330 hp. Heine, ASME, 180 lb., Detroit Stokers.
1—350 hp. Stirling, 175 lbs. hand fired.
2—207 hp. Geary, 170 lbs. hand fired.
2—175 hp. Atlas, 150 lbs. hand fired.
6—150 hp. 72x18 H. R. T., Ohio Std., 125 lb.

ROTARY CONVERTERS

1—300 kw., G. E., type HCC, 275 v. D.C., 6 phase, 60 cycle, 2300/4000 v. A.C.
1—150 kw., G. E., type HCC, 275 v. D.C., 3 phase, 60 cycle, 2300/4000 v. A. C.

A. C. GENERATORS

3 phase, 60 cycle.

1—625 kva., Allis-Chalmers, 220 volts, 120 r.p.m. D.C. 24x42 Corliss Engine.
1—625 kva., Westinghouse, 2300 volts, 150 r.p.m. D.C. 18x38x30 Hamilton Corliss Engine.
1—500 kw., G.E., 480 volts, 3600 r.p.m. condensing Horizontal Turbine.
1—400 kw., G. E. 220 v., 1800 r.p.m., non-condensing Horizontal Turbine.
1—300 kva., Burke, 480 volts, 200 r.p.m. D.C. 20x20 Erie-Ball Corliss Valve Engine.
1—175 kva., Burke, 480 volts, 257 r.p.m., D.C. to 16x16 Erie-Ball Automatic Engine.
1—62½ kw., Lincoln, 480 volts, D.C. 11x12 Chandler & Taylor Automatic Engine.

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1—300 kw., Triumph, 250 volts, D.C. 15x28x30 Hamilton Corliss Engine.
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New Galvanized Flexible Steel Towers

suitable for 66000-volt construction. Details furnished upon request. Location—Hazleton, Pa.

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New Generator, 45 to 55 v., speed 525 to 675, 500 amperes.

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Advise Your Requirements or Offerings

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USED EQUIPMENT THAT STANDS FACTORY TEST

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High voltage, with lightning arresters and disconnecting switches.

CUT-OUTS AND FUSES

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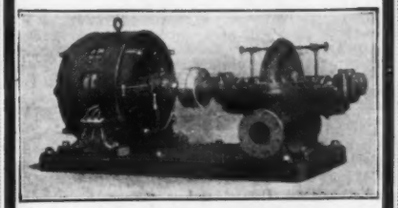

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MOTORS

All motors are interchangeable, 440 or 220 v., 60 cy., 3 ph., A.C., 40 deg., unless otherwise stated, and are complete with starters.

4—7½-hp. Allis-Chal., cage type, 575 r.p.m.
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1— 10-hp. Allis-Chal. motor, cage type, 1200 r.p.m.
1— 50-hp. Westghse. motor, cage type, 575 r.p.m.
1— 75-hp. Allis-Chal., cage type, 690 r.p.m.
1—200-hp. Westghse. motor, slip-ring type, 530 r.p.m.

MOTORS
Large 2200 Volt

2—500-hp. (Type "Any" 14-36-11) Allis-Chal. Fully Enclosed slip-ring, resistance grids and control panels.
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3—250-hp. (Type "Any" 14-36-8½) Allis-Chal. Open Type slip-ring, resistance grids and control panels.

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All Transformers Have Necessary Oil

5—6/10-kva. G.E., 440-110 v.
2— 1-kva. Westghse., 440 v. primary, 110-220 v. secondary.
1— 1-kva. G.E. Transformer, 1040-2080 v. primary, 115-230 v. secondary.
2— 5-kva. Westghse. Transformer, 2200 v. primary, 230-115 v. secondary.
1— 5-kva. G.E. Transformer, 1100-2200 v. primary, 110-220 v. secondary.
3— 10-kva. Wagner, 2200-2300-2400 v. primary, 115-230 v. secondary.
3— 50-kva. Pittsburgh Transformers, 5700-6600 v. primary, 110-220-440 v. sec.
16— 75-kva. Wagner, 220 v. primary, 460-230 v. secondary.
1— 75-kva. Westinghouse, 2200 v. primary, 440-220 v. secondary.
1— 75-kva. Westghse., 2400 v. primary, 480-240 v. secondary.
3—100-kva. Packard, 2300 v. primary, 440 v. secondary.
16—100-kva. Wagner, 2200 v. primary, 460-230 v. secondary.
3—100-kva. G.E., 2300 v. primary, 230-460 v. secondary.
4—200-kva. Wagner Transformers, 6600 v. primary, 220 v. secondary.
7—100-kva. Packard, 33,000 v. primary, 2300 v. secondary.
5—400-kva. G.E., 33,000 v. primary, 2300 v. secondary.
3—500-kva. G.E., 29,700-33,000 v. primary, 2300-4000 v. secondary.

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POSITIONS VACANT

GRADUATE electrical engineer wanted to call on power companies, electric and steam roads. Prefer one with about one year's experience. Considerable travel. Headquarters Chicago. Advise schooling, experience and salary expected. P-414, Elec. World, Old Colony Bldg., Chicago, Ill.

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WORKS manager required for factory in Great Britain about to manufacture silk, cotton and enamel copper wires in large quantities. Only those with expert knowledge will be entertained. Apply P-413, Elec. World, McGraw-Hill Co., 6-8 Bouverie St., London, E. C., England.

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SALARIED men seeking tentative offers of new connections, are invited to communicate confidentially with the undersigned, who will negotiate overtures without jeopardy to present connections. A professional, ethical service, restricted to high grade positions; established 1910. Our "Refund Contract" guarantees refund of retaining fee to the client named therein, if service is not satisfactorily rendered and refund be requested within three months from date remitted. Send name and address only for particulars. R. W. Bixby, Inc., 705 Lockwood Building, Buffalo, New York.

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EXECUTIVES, engineers, sales engineers and draftsmen wanted. We have a constant flow of inquiries for experienced and qualified men from all sections of the country. Write fully; no advance charges. H. H. Harrison & Co., Confidential Employment Service, 19 S. La Salle St., Chicago.

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AN electrical maintenance engineer desires engagement by large mining paper, or industrial company. Fully competent to take entire charge of your plant and operate it efficiently. 66,000 volt experience. Assoc. A.I.E.E. Available immediately. PW-391, Elec. World, 10th Ave. at 36th St., New York.

POSITIONS WANTED

CHIEF electrician, 12 years' experience hydro-electric station installation maintenance and operation, broad experience, desires a change in position. One that offers responsibility and advancement. Age 35. Technical training, E. E. Southeastern location preferred. PW-374, Elec. World, Real Estate Trust Bldg., Phila., Pa.

ELECTRICAL engineer, 13 years' experience, design, construction and operation of power plants and substations both high and low voltage, field and factory, testing, industrial power distribution, specifications, steam, electric and hydro-electric. Desire change in position. PW-298, Elec. World, 10th Ave. at 36th St., New York.

ELECTRICAL engineer, graduate of first class institution, 10 years' experience in operation of large electric furnace plants with high tension auxiliary sub-stations. Acted as executive over personnel of factory, being successful in labor handling. 37 years of age. Desires position as manufacturing executive. PW-388, Elec. World, 10th Ave. at 36th St., New York.

ELECTRICAL engineer, 20 years' experience managing public utilities serving light, power and street railways. Successful records for business building and economical operation. Excellent references. PW-365, Elec. World, 10th Ave. at 36th St., New York.

ELECTRICAL engineer, with initiative, character and experience in station layouts, substation and switchboard design, 15 years; now employed, desires change; Salary $3,600. Available on short notice. PW-407, Electrical World, 10th Ave. at 36th St., New York.

ELECTRICAL engineer, experienced in factory maintenance and construction, desires position as electrical engineer or chief electrician. Available after Jan. 1st. PW-410, Elec. World, Real Estate Trust Bldg., Phila., Pa.

GRADUATE electrical-mechanical engineer, age 37, 12 years' broad experience in sales, construction, inspection and testing, desires position as inspector of materials, equipment, installations or other inspection work. Now employed. PW-369, Elec. World, Real Estate Trust Bldg., Phila., Pa.

GRADUATE electrical engineer, executive ability, age 34, single, available for responsible position with public utility preferably affording business connection. Twelve years' varied technical and commercial experience with large gas and electric companies covering engineering, operation, accounting, power sales, rates, and construction. PW-406, Electrical World, Old Colony Bldg., Chicago, Ill.

GRADUATE electrical engineer of executive ability desires position. Seven years' experience in manufacturing special apparatus and devices; also research. Married. PW-404, Electrical World, 10th Ave, at 36th St., New York.

METERMAN, technical education, 6 years' experience, last three as foreman of department. Familiar with metering, installation and maintenance, power and demand, AC and DC, up to 33 kv. Assoc. A.I.E.E., age 26, married; would consider a chance at operating or industrial work, or laboratory or metering. Employed at present. Must be fair sized town. PW-409, Elec. World, Old Colony Bldg., Chicago, Ill.

SETTLED single man wants position with hydro-electric company, as electric generating or switching station repairman. Can handle any electrical repair, installation of new equipment, relays, switchboard wiring, battery work. Can operate hydro station, or fill position of assistant foreman or superintendent. Am permanently employed, and can furnish good references from present and past employers. Will go anywhere. PW-364, Elec. World, Real Estate Trust Bldg., Phila., Pa.

AGENCIES WANTED

General Sales Engineers
with New York headquarters open for sales agency of a marketable engineering product of broad application. AW-400, Electrical World, 10th Ave. at 36th St., New York.

SALESMEN WANTED

Young Man With Electrical Experience
wanted to sell carbon brushes in Middle West. Salary, commission and expenses. SW-415, Elec. World, Real Estate Trust Bldg., Phila., Pa.

SALESMEN AVAILABLE

SALESMAN with extensive experience in the sale of Electrical Insulating Materials seeks connection with a manufacturer. Qualified as executive or traveling representative. SA-401, Electrical World, 10th Ave. at 36th St., New York.

PATENT ATTORNEY

PATENTS—Send for form "Evidence of Conception" to be signed and witnessed. Form fee schedule, information, free. Lancaster and Allwine, 450 Ouray Bldg., Washington, D. C.

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Light and Power Plant
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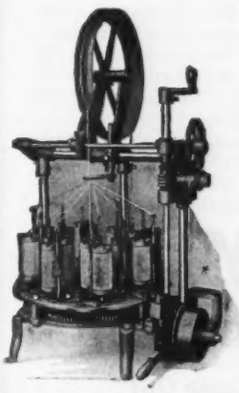

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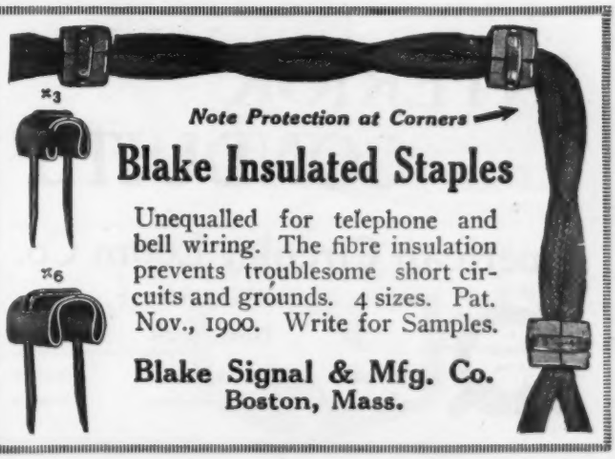

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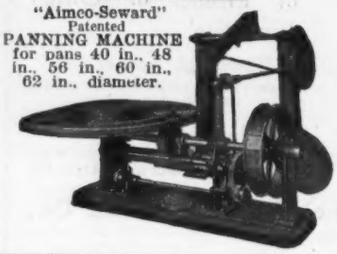

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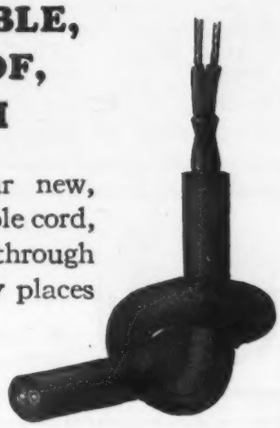

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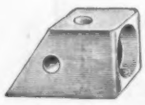

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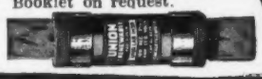

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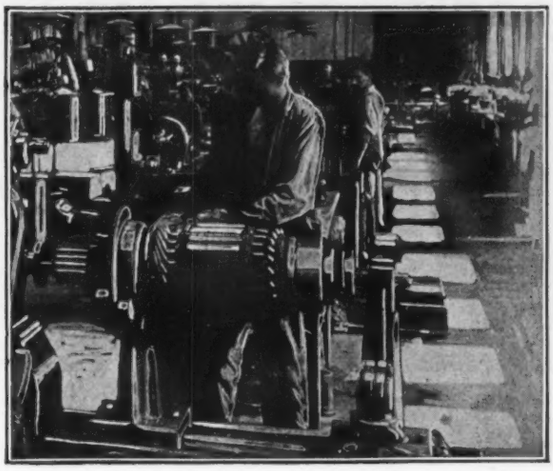

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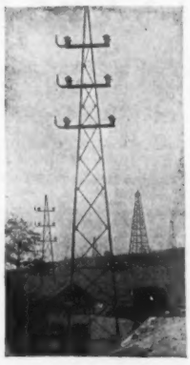

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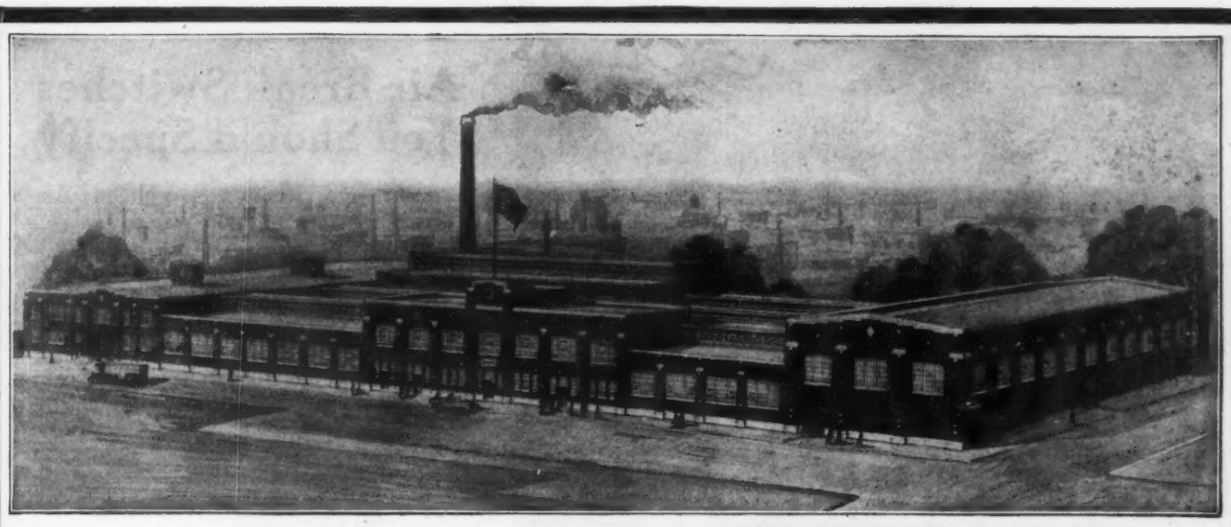

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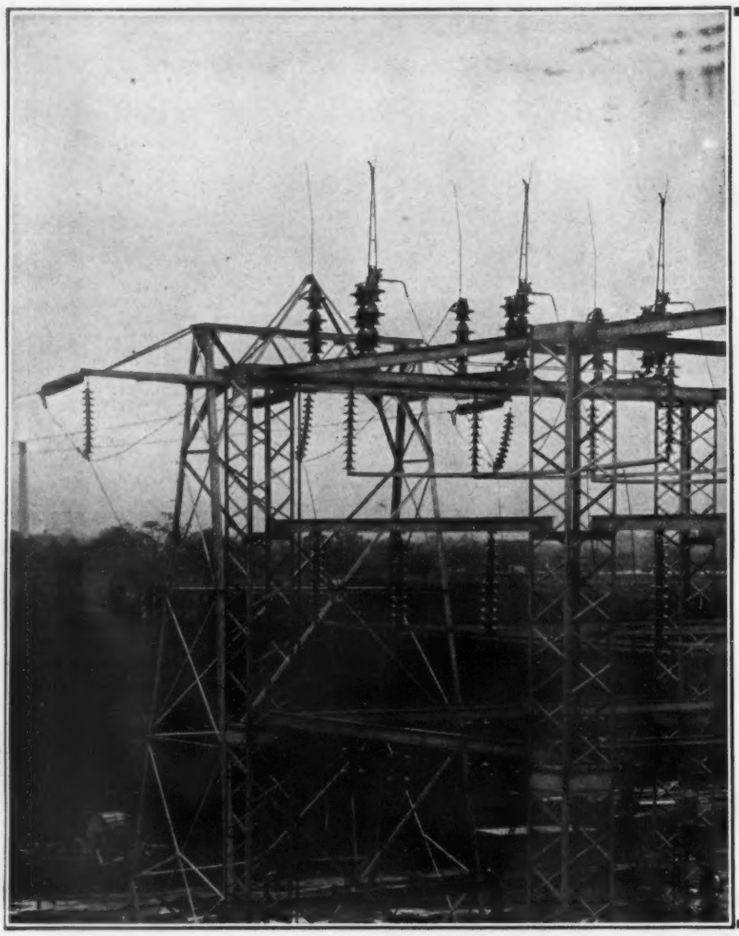

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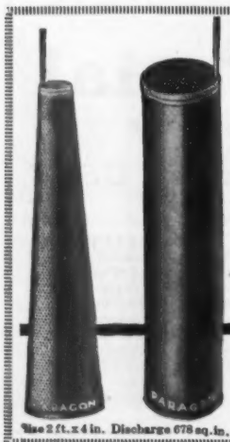

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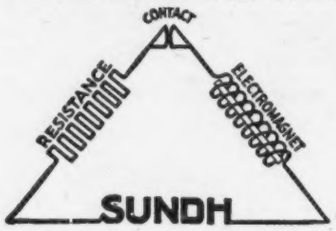

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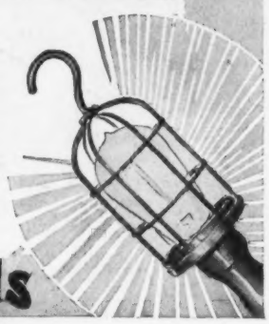

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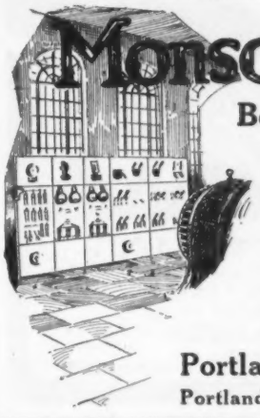

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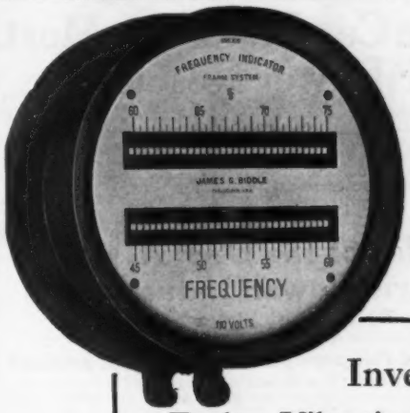

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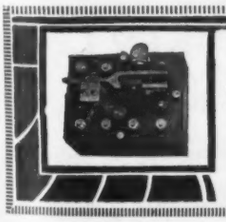

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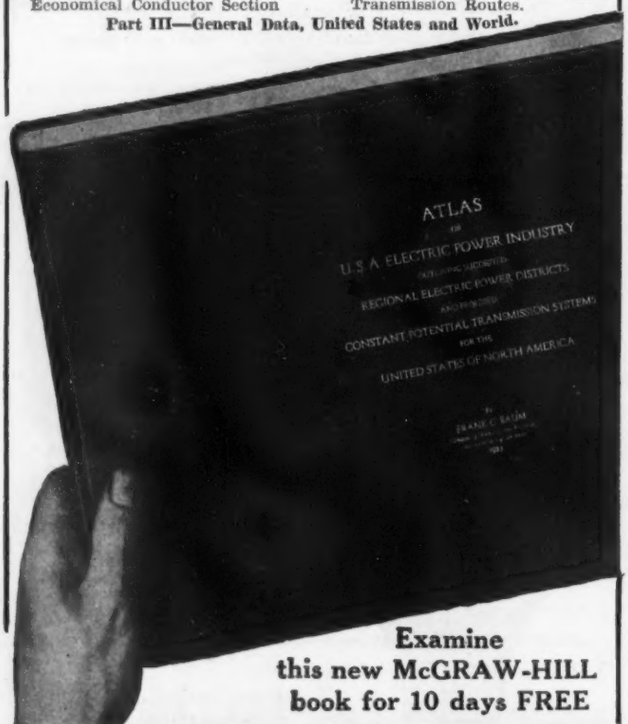

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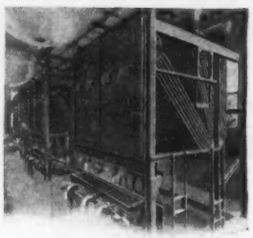

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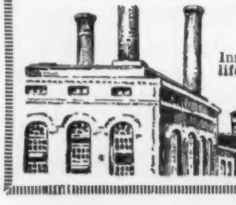

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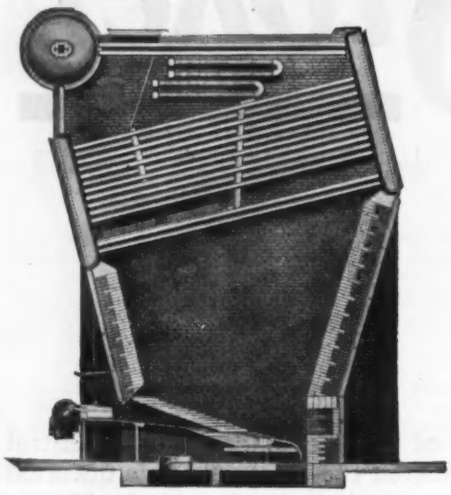

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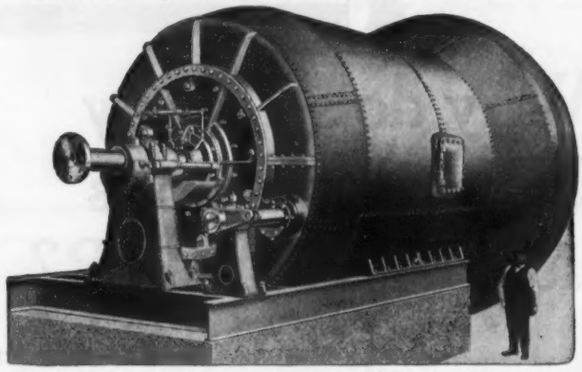

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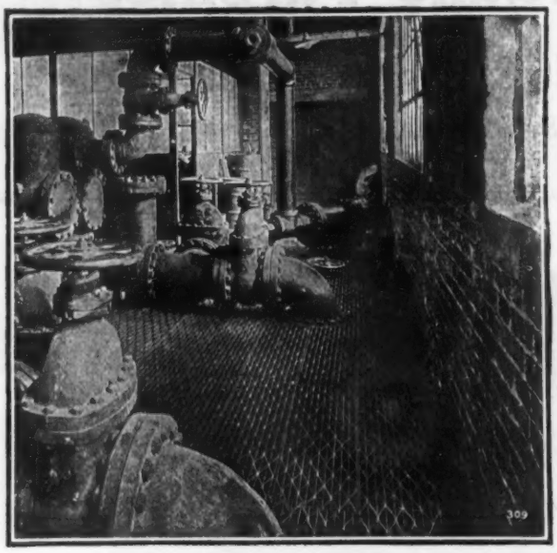

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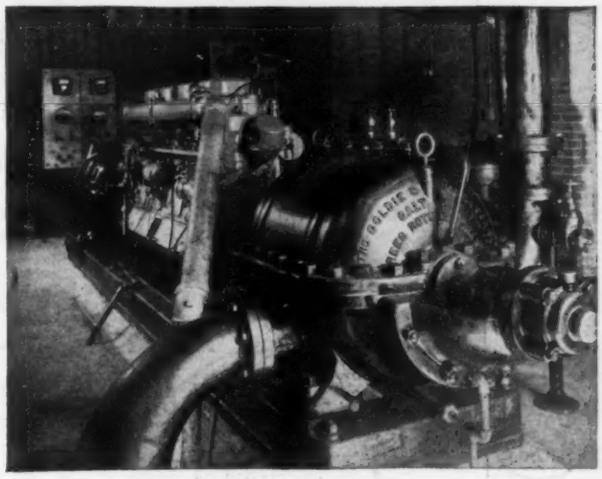

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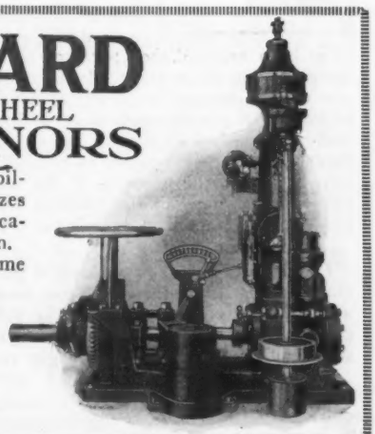

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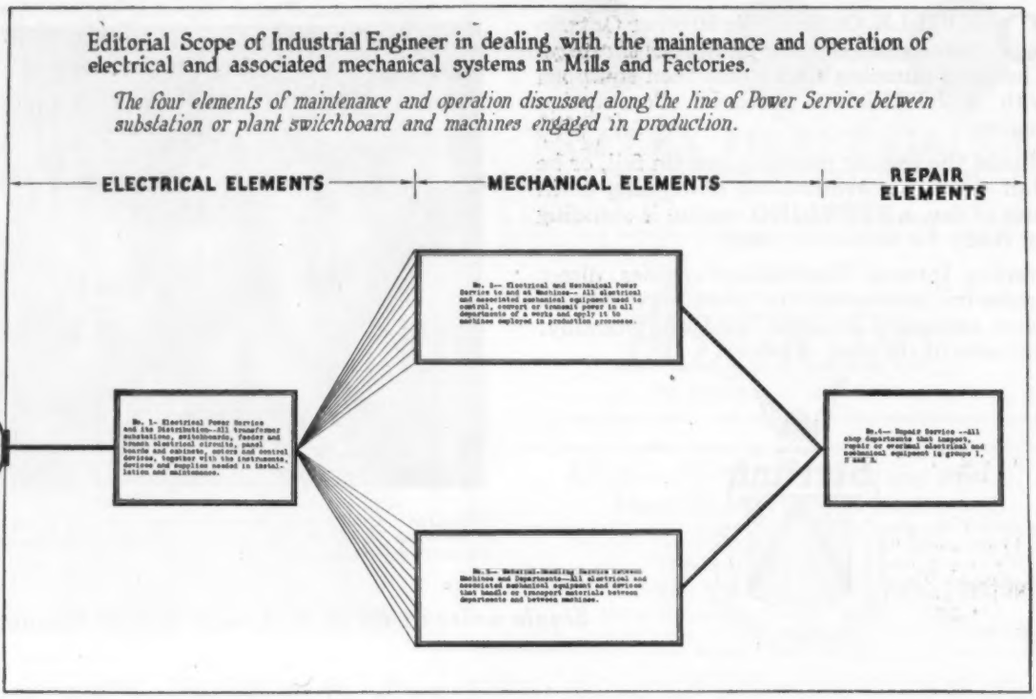
Editorial Scope of Industrial Engineer in dealing with the maintenance and operation of electrical and associated mechanical systems in Mills and Factories.
The four elements of maintenance and operation discussed along the line of Power Service between substation or plant switchboard and machines engaged in production.
ELECTRICAL ELEMENTS
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THE editorial service of *Industrial Engineer* is wrapped around the practical details of everyday jobs. For men responsible for the operation and maintenance of electrical and associated mechanical systems in all industrial works it is their handbook for better operating practices, the ways other men are handling maintenance problems. Moreover, it is their guide to reduced operating costs and the elimination of waste through reduction of costly shutdowns.

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Articles which appear in the paper deal with the problems that lie along the path of power service that extends from the point where power service is received in the plant through all the equipment which represents power service up to the pulley of the machine engaged in actual production.

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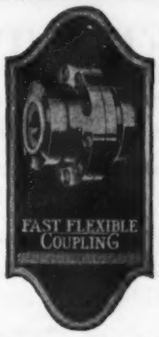

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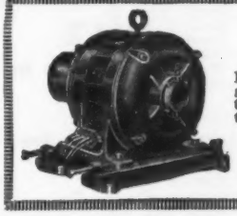

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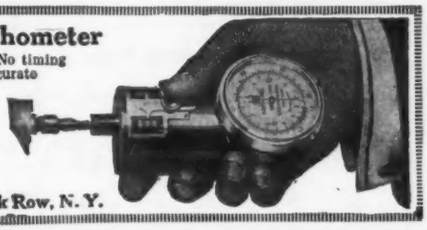

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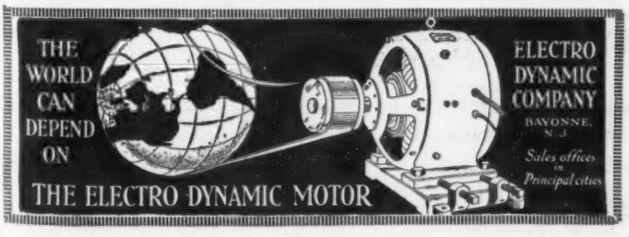
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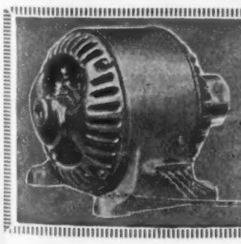
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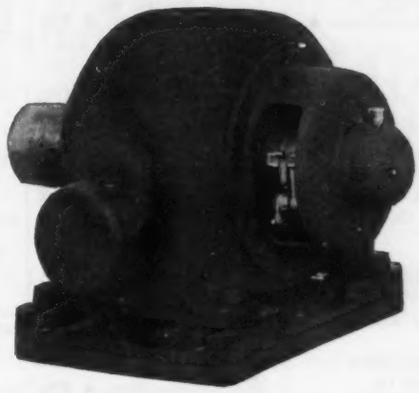
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Locke Insulator Corp.
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General Porcelain Co.
Imperial Porcelain Works
Lapp Insulator Co., Inc.
Locke Insulator Corp.
Ohio Brass Co.
Thomas & Sons Co., R.
Westinghouse Elec. & Mfg. Co.
Post Type
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Electrical Development & Mach. Co.

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Electrical Testing Laboratories

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Arc
General Electric Co.
Westinghouse Elec. & Mfg. Co.
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Consolidated Elec. Lamp. Co.
General Electric Co.
Western Electric Co.
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General Electric Co.

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Elec. Service Supplies Co.
Electrical Engineers Equip. Co.
Electro Service Co.
General Electric Co.
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Hubbard & Co.
Railway & Indus. Engr. Co.
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Shaw, Henry M.
Westinghouse Elec. & Mfg. Co.

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Electric Service Sup. Co.
General Electric Co.
Hubbard & Co.
Line Material Co.
Westinghouse Elec. & Mfg. Co.

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Gifford-Wood Co.

Lugs
Sherman Mfg. Co., H. B.

Magnets
Coto-Coil Co.
Dudlo Mfg. Co.
Elec. Controller & Mfg. Co.

Manganin
Baker & Co., Inc.

Meter Testers
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Meters, Electric & Flow (See Instruments, Electric & Boiler Room)

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Molded Insulation (See Insulation, Molded)

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National Metal Molding Co.

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Condensite Co. of Amer.
General Bakelite Co.
Redmanol Chem. Prod. Co.

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Burke Elec. Co.
Century Electric Co.
Colonial Fan & Motor Co.
Crocker-Wheeler Co.
Diehl Mfg. Co.
Electro-Dynamic Co.
General Electric Co.
Gregory Electric Co.
Imperial Elec. Co
Kimble Electric Co.
Peerless Electric Co.
Reliance Elec. & Eng. Co.
Ridgway Dynamo & Eng. Co.
Star Elec. Motor Co.
Sturtevant Co., B. F.
Wagner Electric Corp.
Western Electric Co.
Westinghouse Elec. & Mfg.
Woods Mach. Co., S. A.
Zobell Elec. Motors Co.
Small
Reynolds Electric Co.

Oil Engines (See Engines)

Oil Pressure Governors
Lombard Governor Co.

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Westinghouse Elec. & Mfg. Co.

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Westinghouse Elec. & Mfg. Co.

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General Elec. Co.
Westinghouse Elec. & Mfg. Co.

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Pelton Water Wheel Co.

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Leeds & Northrup Co.

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Superheater Co.

Pipe Frame Fittings, Electrical
Schweitzer & Conrad, Inc.

Pipe
Riveted Steel
Riter-Conley Co.

Platinum
Baker & Co., Inc.

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National Metal Molding Co.

Plugs, Attachment
Cutler-Hammer Mfg. Co.
General Elec. Co.
Westinghouse Elec. & Mfg. Co.

Pole Line Hardware
Electric Service Sup. Co.
Hubbard & Co.
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Poles, Reinforcing of
Hubbard & Co.

Poles
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Archbold-Brady Co.
Steel
Milliken Bros. Mfg. Co.
Pacific Coast Steel Co.
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Wood
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Naugle Pole & Tie Co.
Northern Pole & Lumber Co.
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Porcelain (See Insulating Material, China and Porcelain

Posts, Wood
Naugle Pole & Tie Co.

Potentiometers
Biddle, James G.
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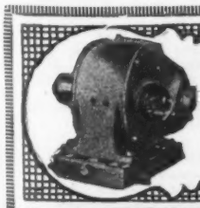

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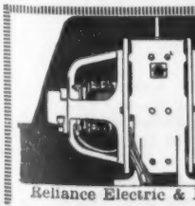

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Steam
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Varnished Cambric
Okonite Co., The

Wireless Apparatus
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X-Ray Apparatus
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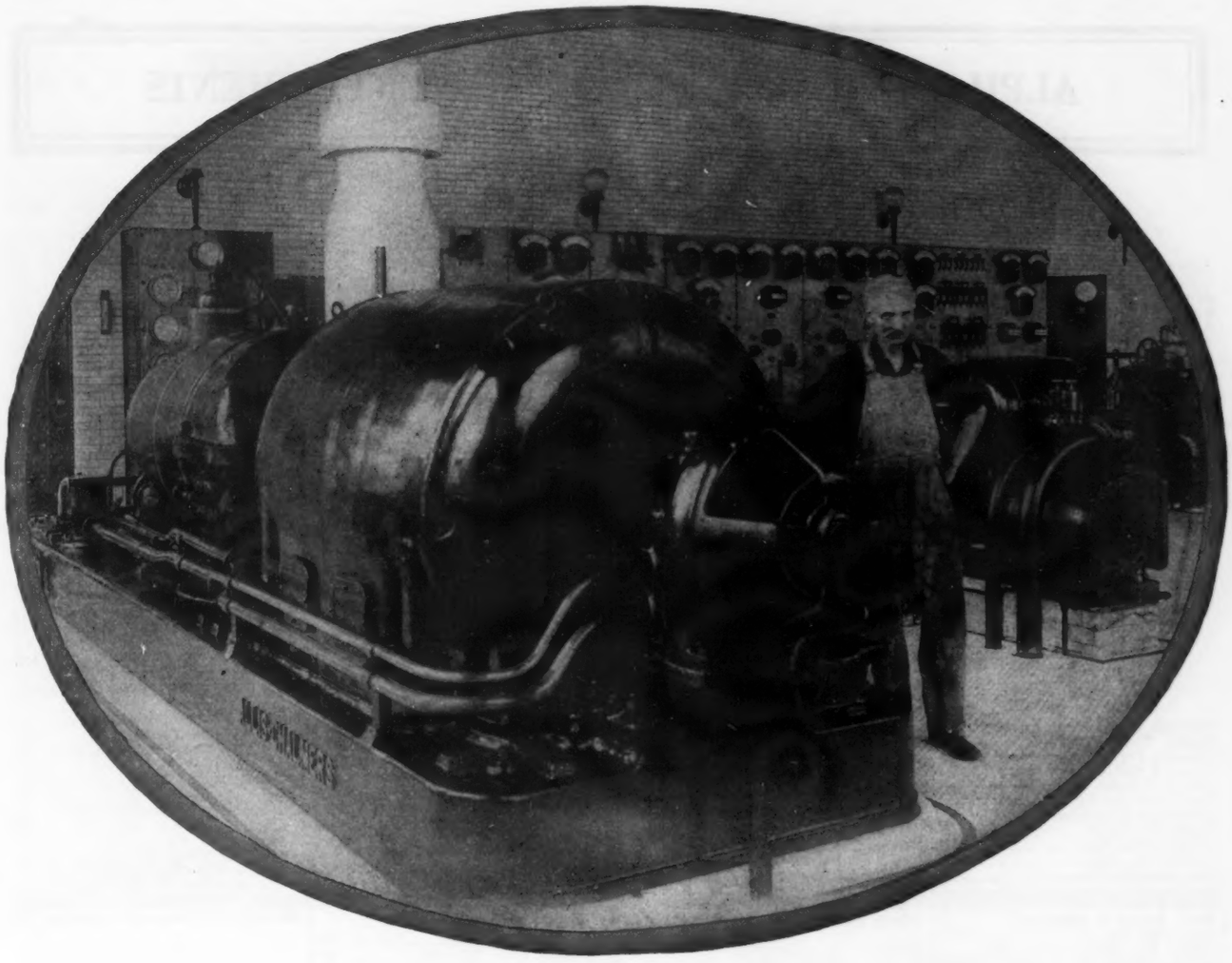

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ALPHABETICAL INDEX TO ADVERTISEMENTS

Page

A

Allis-Chalmers Mfg. Co. 75
Allison & Co., Jas. E. 36
Aluminum Co. of America 13
American Blower Co. 60
American Circular Loom Co. 48
American Enameled Magnet Wire Co. 47
American Engineering Co. 61
American Insulated Wire & Cable Co. 47
American Insulatg. Mchy. Co. 48
American Lava Corp. 50
American Sheet & Tin Plate Co. 50
American Steel & Wire Co. 47
American Transformer Co. 56
Anaconda Copper Mining Co. 48
Anderson Mfg. Co., A. & J. M. .. 57
Antauga Oil & Fertilizer Co. 49
Archbold-Brady Co. 54
Archer & Baldwin, Inc. 42
Arnold Co. 36
Austin Co. 23

B

Babcock & Wilcox Co. 62
Baehr, William A. 36
Bakelite Corp. 50
Baker & Co., Inc. 48
Baldor Electric Co. 73
Bartlett Hayward Co. 69
Bates Expanded Steel Truss Co. B. C.
Baum, Frank G. 36
Belden Mfg. Co. 47
Belyea Co., Inc. 43
Bell Lumber Co. 55
Biddle, Jas. G. 59
Bigelow Co. 62
Blake Signal & Mfg. Co. 47
Brenholts, Roy 44
Bristol Co., The 59
Buffalo Forge Co. 64
Burke Electric Co. 73
Busch-Sulzer Bros. Diesel Eng. Co. 67
Bussmann Mfg. Co. 57
Byllesby 36

C

Cameron Elec. Mfg. Co. 58
Candy & Company, Inc. 50
Carrier Air Conditioning Co. of America 64
Celite Products Co. 66
Century Electric Co. 73
Cheney, Edw. J. 36
Chicago Fuse Mfg. Co. 50
Chicago Pump Co. 64
Colonial Fan & Motor Co. 73
Combustian Engr. Corp. 63
Condensite Co. of America 50
Condit Elec'l Mfg. Co. 4, 11
Connelly Boiler Co., D. 60
Consolidated Elec. Lamp Co. 58
Cooper & Co., Hugh L. 36
Cory & Son, Inc., Chas. 59
Coto-Coil Co. 48
Cramp & Sons Ship & Eng. Bldg. Co., Wm. 65
Crocker-Wheeler Co. 71
Cutler-Hammer Mfg. Co. 58

D

Day & Zimmermann, Inc. 36
Delta-Star Electric Co. 10
Detroit Elec. Furnace Co. 67
Diamond State Fibre Co. 51
Diehl Mfg. Co. 73
Directory of Engineers 36-37
Dudlo Mfg. Co. 47
Duncan Electric Mfg. Co. 12

Page

E

Electric Bond & Share Co. 51
Electric Furnace Constr. Co. 66
Electric Power Equip. Corp. 55
Electric Service Supplies Co. 58
Electrical Development & Mach. Co. 57
Electrical Engineers Equip. Co. . 7
Electrical Testing Lab. 36
Electrical World 3
Electro Dynamic Co. 69
Electro Service Co. 52
Elliott Company 25
Ellis, A. Lee 43
Engineers' Directory 36-37

F

Fargo Engineering Co. 36
Ford, Bacon & Davis 36
Fowle, Frank F. 36
Foxboro Co., Inc., The 66
Freeman, Roger M. 36
Fuller-Lehigh Co. 60

G

G. & W. Elec. Spec. Co. 8
Gannett, Seelye & Fleming, Inc. . 36
Garfield Mfg. Co. 50
General Bakelite Co. 50
General Electric Co. 27, 28, 29, 30, 31, 32, 33, 34
General Porcelain Co. 52
General Radio Co. 59
Gregory Electric Co. 38
Grey Steel Products Co. 44

H

Hall & Co., Stephen 40
Harza, L. F. 36
Hayward Co., The 66
Hemingray Glass Co. 53
Hemphill & Co., Inc., J. L. 40
Hilgartner Marble Co. 45
Hi-Voltage Equipment Co. 54
Hubbard & Co. 53

I

Illinois Wire & Cable Co. 48
Imperial Electric Co. 73
Imperial Porcelain Works 51
Indiana Rub. & Ins. Wire Co. 3rd Cover
Industrial Engineer 68
Irving Iron Works Co. 66
Irvington Varnish & Ins. Co. 51
Ives & Davidson 36

J

Jeandron, W. J. 71

K

Kansas City Power & Light Co. 42
Kerr Turbine Co. 64
Kimble Electric Co. 71
Kirchberger & Co., Inc., M. 50
Klein & Co., Nathan 44-45
Krehbiel Co. 36
Kuhlman Electric Co. 56

Page

L

Land, J. L. 44
Lapp Insulator Co., Inc. 52
LeCarbone Co. 71
Lecourtenay Co. 64
Lee, Wm. S. 36
Leeds & Northrup Co. 59
Leffel & Co., James 62
Lincoln Co., E. S. 36
Line Material Co. 55
Lippman, H. 44
Locke Insulator Corporation ... 52
Lombard Governor Co. 67

M

McClellan & Junkersfeld 36
McGraw-Hill Book Co. 23, 60
Manistee Iron Works Co. 64
Marble-Card Electric Co. 73
Maris Bros. 66
Massachusetts Mach. Shop, Inc. 69
Mead, Daniel W. 36
Metropolitan Device Corp. 2
Miami Conservancy Dist. 45
Miller-Owen Elec. Co. 44
Milliken Bros. Mfg. Co. 54
Mincho & Phillips 36
Moloney Electric Co. 57
Moore & MacDonald 42
Morganite Brush Co. 69
Morse Chain Co. 69
Mullergren, Arthur L. 36
Munsell & Co., Eugene 50

N

National Carbon Co. 20
National Elec. Mfg. Co. 22
National Metal Molding Co. 49
National Power Machy. Co. 44
Naugle Pole & Tie Co. 55
Neall, N. J. 38
New England Butt Co. 47
Northern Engineering Works. . 66
Northern Industrial Chemical Co. 50
Northern Pole & Lumber Co. 55
Nussbaum & Co., V. M. 44

O

Ohio Brass Co. 6
Okonite Co., The 49
Ophuls & Hill, Inc. 36
Oshkosh Mfg. Co. 57

P

Pacific Coast Steel Co. 54
Packard Electric Co. 56
Paragon Electric Co. 56
Parsons, Klapp, Brinckerhoff & Douglas 36
Partridge Lumber Co., T. M. 55
Payne, Dean, Ltd. 60
Peerless Electric Co. 71
Pelton Water Wheel Co. 64
Pittsburgh Elec. Furnace Corp. . 67
Pittsburgh Transformer Co. 56
Portland-Monson Slate Co. 59
Power Machinery Co. 43
Power Specialty Co. 62
Public Service Prod. Co. 36

R

Railway & Industrial Eng. Co. . 54
Randle Machy. Co. 45
Redmanol Chem. Prod. Co. 50

Page

Reed, W. Edgar 37
Reliance Elec. & Engrg. Co. 73
Reynolds Elec. Co. 69
Ridgeway Dynamo & Eng. Co. . 58
Riley Stoker Co., Sanford 60
Riter-Conley Co. 54
Robinson & Co., Dwight P. 37
Roebling's Sons Co., John A. 48
Roller-Smith Co. 58
Rome Brass & Copper Co. 58
Ross Power Equipment Co. 44
Ryle & Co., Wm. 48

S

S.K.F. Industries 21
Sachsenmaier Co., George 41
Safety Ins. Wire & Cable Co. 49
Samson Cordage Works 49
Sanderson & Porter 37
Sargent & Lundy 37
Sayer, E. Y. Eng'g Corp. 37
Scheidenhelm, F. W. 36
Scheinert Co., R. 43
Schweitzer & Conrad, Inc. 9
Scofield Engr. Co. 37
Scovill Mfg. Co. 64
Searchlight Section 38, 46
Sewickley Electric Mfg. Co. 58
Shaw, Henry M. 52
Shelton Electric Co. 58
Sherman Mfg. Co., H. B. 48
Simplex Wire & Cable Co. 49
Smith Co., S. Morgan 64
Spooner & Merrill 37
Standard Underground Cable Co. 47
Star Electric Motor Co. 69
Sterling Eng. Co. 67
Stevens & Wood, Inc. 37
Steward Mfg. Co., D. M. 50
Sturtevant Co., B. F. 24
Sundh Electric Co. 58
Superheater Co. 60

T

Taylor Instrument Co. 64
Terry Steam Turbine Co. 64
Thebo, Starr & Anderton, Inc. . 37
Thomas Elevator Co. 44
Thomas & Sons Co., R. 53
Tiffany Electric Co. 39
Trumbull Electric Mfg. Co. 59

U

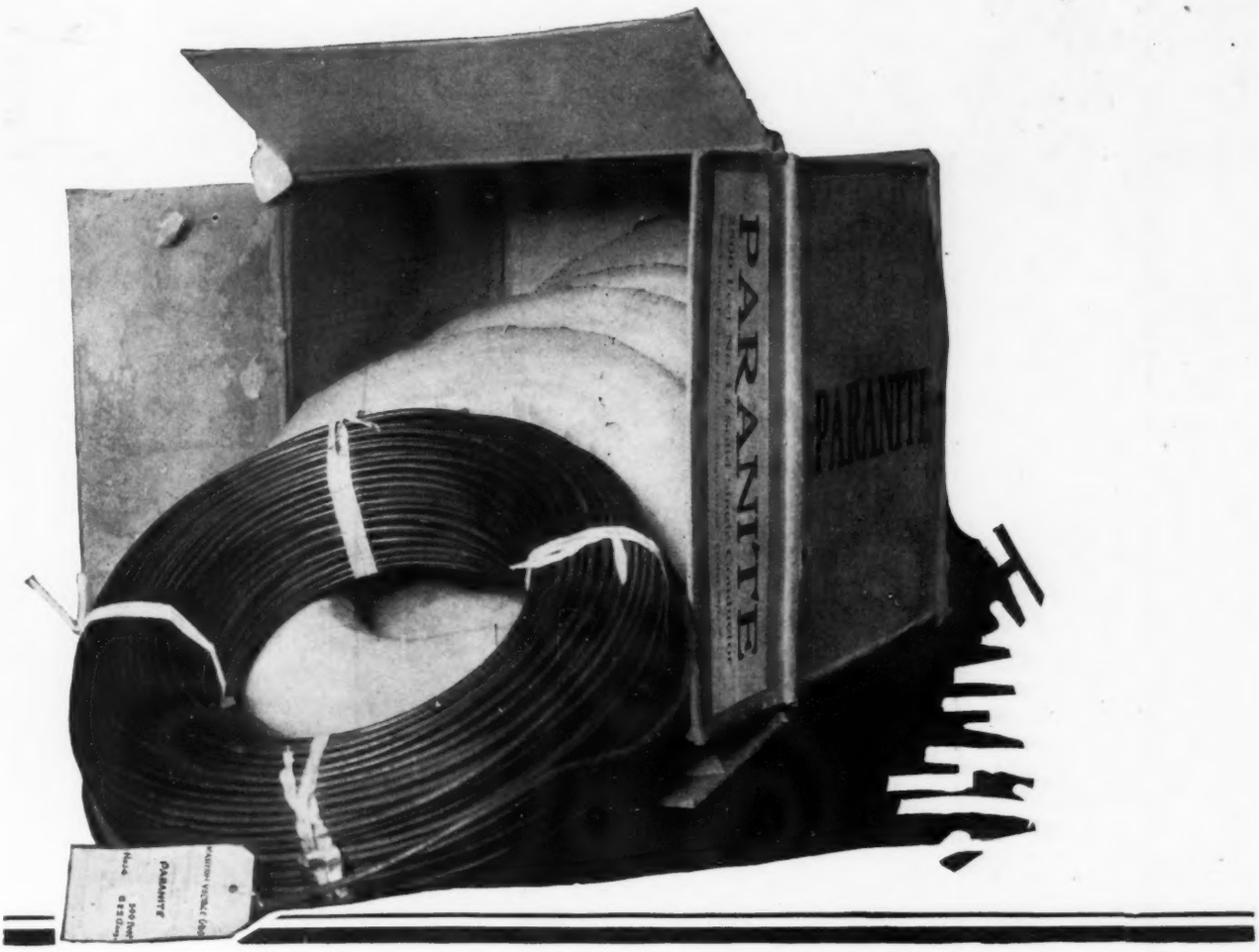
Universal Crane Co. 66

W

Wagner Elec. Corp. 18-19
Wallace Co., Inc., J. V. 44-45
Ward Leonard Electric Co. 59
Werby & Co., A. 44
Western Electric Co. 5
Westinghouse Elec. & Mfg. Co. 14, 15, 16, 17
Wheeling Steel Corporation 50
White Engr. Corp., J. G. 37
Wickes Boiler Co. 62
Williams, Gardner S. 37
Wilmington Fibre Spec. Co. 51
Wireless Spec. Apparatus Co. 56
Wisconsin Traction Lt., Heat & Power Co. 44
Woods Mach. Co., S. A. 71
Wood & Weber 37
Woodward Governor Co. 67
Worthington Pump & Machy. Corp. 26

Z

Zelnicker in St. Louis 45
Zernickow, O. 69
Zobell Elec. Motors Co. 71



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